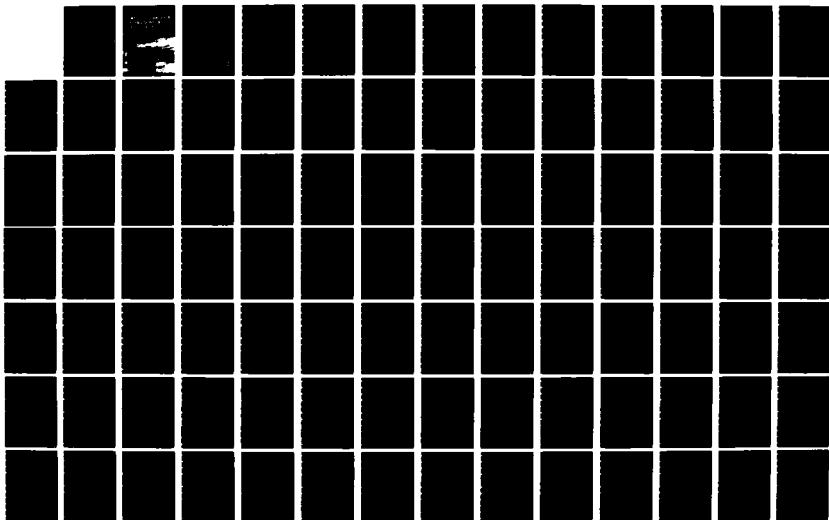


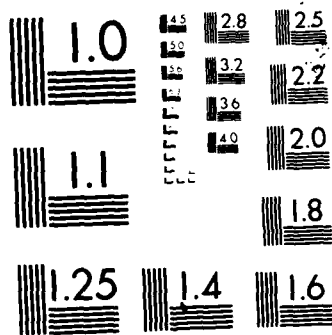
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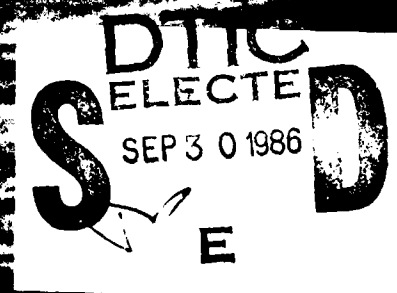


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UNIVERSITY CURRICULA IN OCEANOGRAPHY AND RELATED FIELDS

AD-A172 424



FROM THE OFFICE OF
OCEANOGRAPHIC OFFICE
HEADQUARTERS, NAVY
OCEANOGRAPHY COMMAND

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distribution is unlimited.

FOREWORD

Covering nearly three-quarters of the surface of the Earth, the oceans play a unique role in sustaining life and in shaping human objectives. As our understanding of the oceans and their influence on our physical world increases, opportunities for human enrichment also increase. The future well-being of the human race is inextricably linked to knowledge of the oceans, the seafloor, and the airspaces above. The Navy has a special interest in the character and behavior of the oceans because they are our operational environment.

"University Curricula in Oceanography and Related Fields" serves as a guide for men and women interested in educational opportunities to enhance their general understanding of how the oceans affect our daily lives. We will gain a full measure of the benefits of such knowledge only if we are ready, willing and able to apply our skills to the challenges of the ocean world.

We wish to acknowledge the cooperation of the many educational institutions and agencies that provided the information compiled in this edition.

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J.R. Seesholtz
 J.R. SEESHOLTZ
 Commodore, U.S. Navy
 Oceanographer of the Navy



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INTRODUCTION

General

This edition of *University Curricula in Oceanography and Related Fields*, the tenth in a series inaugurated by the Interagency Committee on Oceanography, is designed to inform students and guidance counselors which colleges and universities offer marine courses.

The purpose of the catalog is to provide a guide to, rather than a definitive description of, current offerings in the marine field. Students, counselors and others should use this publication to select institutions to contact for complete information concerning admission requirements, scholarship-fellowship availability, specific courses which are being offered during particular semesters and related matters.

Information was provided by officials at each college, university or institution listed. As the material was gathered during the early part of 1982, references in some of the program descriptions to "this year" likely mean the 1981-82 academic year.

The criterion for including a college, university or institution in this edition was that it offer a program of at least 25 semester hours (broadly defined) in the marine field. Although the number of responding institutions has increased since the last edition, several institutions which would otherwise qualify were not able to prepare their material in time for inclusion.

Institutions were to include programs in all areas of marine studies, from two-year technology training courses to Ph.D. offerings. Programs in marine law, fisheries and food science, the maritime field and naval architecture were specifically included, as well as any new interdisciplinary programs that might fall outside traditional organizational structures.

Reports from the institutions are listed alphabetically and are organized as follows:

- A description of the facilities available, including research labs and vessels;
- the degree programs in the marine field, usually with the entrance and course requirements specified;
- an address for further information, and
- a geographic index to help identify facilities in a particular region is also given.

Scholarship Information

There are a number of excellent guides to scholarship information available. Without exception, they point to the institutions themselves as the principal source of information, but nonetheless, provide useful descriptions of the different types of aid programs available.

"Need a Lift?", one of the best guides, is published annually by the American Legion. It is published each fall and one copy is available free by writing to the American Legion National Headquarters, P.O. Box 1055, Indianapolis, Indiana 46206. Additional copies are available for 50¢ each. While this brochure is naturally heavy in emphasis on aid to children of veterans, it is a comprehensive listing of government, business and organization-provided aid. Included in the American Legion publication is a list of books carried in most libraries which provide guides to colleges and scholarship assistance. The booklet also provides a state-by-state list of educational benefits and eligibility requirements for each.

Students and counselors would also be well advised to contact a U.S. Representative or Senator from their home state for copies of available Federal Government documents describing current aid programs. Such programs often undergo change and it would be important to obtain the most recent information available. The U.S. Office of Education currently makes available a one-page fact sheet outlining its aid programs.

High School guidance offices will have information available about sources of financial aid and can provide leads to publications available in their local area which provide further information.

Career Guidance

Students looking into the marine field as a possible future career would do well to talk to as many people familiar with the field as possible. Oceanography has attracted considerable worldwide attention and has also been the object of some exaggerated estimates of future growth as a field of endeavor.

The booklet, "The Oceans and You," published by the Marine Technology Society (\$3.00 prepaid), 1730 M Street, N.W., Suite 412, Washington, D.C. 20036, is a realistic guide to the field from the career standpoint. Included are two introductory discussions of the field, job descriptions from sample employers among private industry, government agencies and universities; a capsule list of institutions offering marine programs; a comprehensive reading list; a description of marine technician training programs; a list of sources of additional information about the field, and some suggestions about personal actions for any interested individual. Other career guidance publications which have been produced in recent years and might still be available include: *So You Want to Be a Marine Scientist*, Miami Seaquarium, Rickenbacker Causeway, Miami, Florida 33149; *Geophysics, the Earth in Space*, American Geophysical Union, 1707 L Street, N.W., Washington, D.C. 20036; *Your Career in Oceanology*, by Norman H. Gaber, Richards Rosen Press, New York, 1967; and *Training and Careers in Marine Science*, International Oceanographic Foundation, Virginia Key, Miami, Florida 33149.

Good sources of general information are the Federal Government agencies with marine programs. Among them are:

Department of Commerce; National Oceanic and Atmospheric Administration and Maritime Administration,

Department of the Interior; Geological Survey and Bureau of Sport Fish and Wildlife,

Department of the Navy; Office of Naval Research, Naval Oceanographic Office and Naval Oceanography Command, and

Department of Transportation; U.S. Coast Guard.

Additional information may be obtained from such diverse sources as the Department of State, Smithsonian Institution and Environmental Protection Agency.

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ADELPHI UNIVERSITY
Garden City, Long Island, New York 11530

Marine related activities at Adelphi University are centered in the Departments of Biology, Earth Science and Physics. Currently, the instructional and research energies of eight faculty are marine oriented. The Departments of Biology and Earth Science offer the Marine Science degree with a marine orientation. The University maintains the *R/V Shuttle*, and a Boston Whaler, to implement programs of research and education. Opportunities for oceanographic cruise experience and research are available and encouraged.

Equipment available for estuarine and ocean teaching and research include induction salinometers, submarine photometer, otter trawl, seine nets, oxygen analyzers, specific-ion probes, pH meters, spectrophotometers, microscopes, photographic equipment, scuba gear, climate control chambers, centrifuges, a seismic hammer with six chambers, and water and bacteriological samplers.

The Following degrees are offered:

1. **B.A. Interdisciplinary Major in Marine and Environmental Science**, sponsored by the Biology and Earth Science Departments and the Institute of Marine Science. Degrees granted: 12.

- | | |
|------------------|------------|
| a) Biology | 20 credits |
| b) Earth Science | 20 credits |
| c) Chemistry | 12 credits |
| d) Physics | 8 credits |
| e) Mathematics | 8 credits |

2. **M.S. in Biology** with specialization in Marine Biology. Degrees granted: 62.

Thirty-three credits including 6 for thesis research. Comprehensive examination, oral or written.

3. **M.S. in Earth Science** with specialization in Marine Science and Environmental Science. Degrees granted: 15.

Successful completion of 33 graduate credits as follows:

- | | |
|------------------|---------------|
| a) Earth Science | 21-24 credits |
| b) Mathematics | 3-6 credits |
| c) Electives | 3-6 credits |

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Marine Program Coordinator

Department of Biology

Adelphi University

Garden City, Long Island, NY 11530

ALABAMA STATE UNIVERSITY
Montgomery, Alabama 36195-0301

Alabama State University, through affiliation with the Marine and Environmental Sciences Consortium at Dauphin Island, Alabama, offers a major in Biology with an emphasis in Marine Biology, designed for those

students interested in this area. Students pursuing this program are required to complete the general college requirements and a minimum of 25 quarter hours of Marine Science courses. The courses in Marine Biology are offered only at the Dauphin Island Sea Laboratory (see citation for Marine Environmental Sciences Consortium of Alabama/Dauphin Island Sea Lab.)

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Department of Biology

Alabama State University

P.O. Box 271

Montgomery, AL 36195

(205) 832-6072 x467

THE AMERICAN UNIVERSITY
Washington, D.C. 20016

The American University offers to students one of the most unique and diverse marine science academic programs in the nation. Nearly *one hundred courses* are offered in environmental and marine sciences, with about half on campus and half at field stations or marine laboratories or aboard ship.

The American University (A.U.) has affiliations or memberships with selected regional marine institutions including: (1) the Marine Science Consortium, (2) Sea Education Association, (3) the U.S. National Park Service (*Lightship Chesapeake*), (4) U.S. National Aquarium. Affiliations are pending with (1) the Gulf Coast Research Laboratory, Ocean Springs, Mississippi, and (2) the Jean-Michel Cousteau Institute (Project Ocean Search Expeditions). Participation in these numerous and diverse programs provides students with a multi-habitat (world-wide) marine academic experience. Students register for all course work and research (on and off campus) through A.U.

The variety of field research facilities enables long-term studies of diverse aquatic environments including the ocean, lakes, estuaries, rivers, lagoons, wetlands, and forests. Partly and wholly-funded graduate and undergraduate internships allow local work-study projects in aquaculture, limnology, and environmental education. Research and teaching fellowships are available at the graduate level. Coursework and research facilities are also available through numerous government agencies in the area and through the Washington Area Consortium of Universities (Georgetown University, George Washington University, Howard University, Catholic University and others). In each case, the academic registration is made through A.U.

A.U. faculty funded research interests include remote sensing (wetland mapping, water quality and land use in national parks); ocean dumping of municipal and industrial wastes; environmental assessment and monitoring in lakes, reservoirs, rivers (Columbia, Missis-

issippi, Potomac and the Amazon), estuaries (Chesapeake Bay, Delaware Bay and Chincoteague Bay), and oceans (North Atlantic, Gulf of Mexico, Caribbean, and Mediterranean); distribution and abundance of organisms; invertebrate zoology; fisheries; ecological studies in salt marshes; nationally recognized Project IBIS (Intensive Biometric Intertidal Survey); marine optics/spectral distributions/productivity/respiration and many others.

SEA Semester: Students spend six weeks at Woods Hole, Massachusetts, and six weeks aboard the *Westward* (a 110-foot sailing Ship) in the Atlantic or Caribbean, for 16 undergraduate credit hours.

The Marine Science Consortium at Wallops Island, Virginia: About 25 courses are offered in the field during summers. Opportunities for independent research. Research cruises and Project IBIS (salt marsh research) are especially well known (see citation for The Marine Science Consortium, Inc.).

Graduate and undergraduate degrees in Oceanography, Marine Biology and other similar fields may be arranged as interdisciplinary programs, or as degree programs in the Department of Biology. Marine and environmental specializations are also available in chemistry, physics and other departments. The Biology requirements are given as representatives of many departments; some interdepartmental degree programs also are listed.

1. B.A. in Biology

- a) University Liberal Arts and English requirements 24 credits
- b) Core courses in Biology 37 credits
- c) Elective courses in Biology 3 credits
- d) Related requirements 8 credits
- e) Electives to complete a minimum of 120 credits

2. B.S. in Biology

- a) Free elective courses in Biology 12 credits
- b) University Liberal Arts and English requirements 24 credits
- c) Core courses in Biology 26 credits
- d) Related requirements (chemistry, physics, math and statistics) 34 credits
- e) Electives to complete a minimum of 120 credits

3. Two new degrees: B.S. in Marine Biology and B.S. in Marine Science have been submitted for University approval.

4. M.S. in Biology

Thesis degree with specialization in Marine Biology, Marine Science, or Oceanography.

- a) Minimum of 32 hours of approved graduate work including six hours Master's Thesis Research and two hours of Graduate Seminar

- b) A written comprehensive examination

- c) Successful completion, defense and acceptance of a Master's Thesis

5. B.A. in Environmental Studies

May only be taken as a second major, combined with a traditional B.A. or B.S. degree. The student's final

degree plan must be approved by a faculty member of the student's department and the Environmental Studies Committee when the double major is declared.

- a) A total of 36 credit hours is required for the double major

- b) Required courses — 18 credits

- c) Of the 18 remaining credit hours, 12 hours must be outside the student's major department and his major degree requirements

- d) Of these 18 remaining credit hours, nine credit hours must be .300 level or above

6. M.S.T.M. in Environmental Systems Management

Thesis-option degree offered by the College of Public Affairs, Center for Technology and Administration. Requires the completion of all foundation requirements or their equivalent (approximately nine credit hours), and completion of 36 graduate semester hours in core requirements, field requirements, and thesis requirements or research and/or seminar. Students must successfully complete one comprehensive examination in the main field of concentration.

7. Graduate Certificate in Environmental Systems Management

The Environmental Systems Management Program offers graduate certificate programs in general Environmental Systems Management, Ocean Affairs Management, and Toxic and Hazardous Materials Management: 18 credit hours.

8. Ph.D. in Environmental Chemistry

A minimum of 72 semester hours of graduate work is required.

- a) At least 60 graduate semester hours of chemistry including seven specified courses

- b) Two semester hours of a seminar in chemistry

- c) Twelve to 24 semester hours of Doctoral Dissertation Research

- d) Eighteen of the graduate semester hours must be chosen from the environmental systems management courses offered by the Center for Technology and Administration

9. Ph.D. in Science Education

- a) A minimum of 72 semester hours of graduate credit beyond a bachelor's degree, with at least 12 of these hours being devoted to the dissertation which includes an oral defense. Specific courses may be necessary for certain study areas.

- b) Tools of research

- c) Qualifying examination must be taken before completion of 24 hours of course work

- d) Three written comprehensive examinations and one oral comprehensive examination are required Curriculum offered: available in school catalog. Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director, Environmental and Marine Science

Department of Biology

The American University

Washington, D.C. 20016

(202) 686-2177

BARRINGTON COLLEGE

Barrington, Rhode Island 02806

The Marine Biology program at Barrington College not only serves the students of New England, but students from as far west as California. This program was started in the summer of 1970. Narragansett Bay was the perfect place for marine studies, and the first Summer Institute attracted twenty-five students. These were college students, college professors, and businessmen. From this enthusiastic beginning the Summer Institutes began to accept high school students. It soon became clear that an undergraduate program was needed in Marine Biology. In the mid-1970's a B.A. degree was made available, and has continued to be an outstanding program at Barrington College.

The Summer Institutes provide long periods of time to be involved in study, and time to specialize. The students are with highly-qualified faculty members for about eight hours each day, five days a week. Each Marine Biology Institute lasts three weeks. Three Institutes are held each summer. Two of these Institutes are campus-based with study being done in Narragansett Bay and in the waters of Cape Cod. The third Institute is held at the College's field station in Nova Scotia to learn the ecology and physiology of colder waters. In the January Winterim, a course in Tropical Coastal Waters is held off the coast of Central America.

Besides these concentrated courses taken during the Summer Institutes, the students are required to take marine biology courses, and other basic biology courses during the regular semesters. The students majoring in marine biology must also take at least a year of mathematics, a year of physics, and two years of chemistry. The students are also urged to take courses in computer science.

The regular college faculty is assisted by an outstanding guest and affiliate faculty. Much emphasis is put on field experience and laboratory methods. Systematics and physiology are also stressed. Organismal biology and ecology are considered important. The essential nature of the intertidal zone is the focus in many of the courses. Special field trips are taken to other Marine Study facilities where students have an opportunity to meet and hear other scientists. The motto for this area of study at Barrington College is: "Our second decade of successful outdoor marine education."

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director of Marine Biology

Barrington College

Middle Highway

Barrington, RI 02806

(401) 246-1200

BELLINGHAM VOCATIONAL-TECHNICAL INSTITUTE

Bellingham, Washington 98225

A 41-foot boat, *BelleTech*, is rigged for trawling and purse seine. A net loft is also used at Bellingham harbor for net work.

The Commercial Fishing Course at Bellingham Vocational-Technical Institute is designed to prepare persons with little or no previous experience to enter employment as crew members on commercial fishing vessels. The graduate will be able to serve on board a variety of fishing ships, including those used for purse seining, otter trawling, gillnetting, reef-netting, trolling and halibut fishing.

The Commercial Fishing Course is nine months long. Classes operate five days per week for a total of 1,080 hours. The class schedule is as follows: morning 8:30 a.m. to 11:30 a.m.; lunch 11:30 a.m. to 12:30 p.m.; afternoon 12:30 p.m. to 3:30 p.m. Students may also enroll on a half-time basis, taking either the morning or afternoon class.

The program encompasses:

1. **Introduction to Commercial Fishing**
 - a) Overview of fishing industry
 - b) Common methods of commercial fishing
2. **Orientation to the Vessel**
 - a) Teamwork
 - b) Common deck equipment
 - c) Navigation aids
 - d) Marine terminology
 - e) Work stations
 - f) Crew members and their responsibilities
3. **Seamanship**
 - a) Skiff handling and operation
 - b) Docking, anchoring, and line handling
 - c) Stowage of equipment
 - d) Clothing and protective gear
 - e) Health and personal hygiene
 - f) Conservation of water, electrical power, and other resources
4. **Navigation and "Rules of the Road"**
 - a) Use of navigation aids
 - b) Plotting a course
 - c) Channel markers, passing, signaling, etc.
 - d) Distress signals
5. **Safety Rules**
 - a) As applies to all "on-board" activities (integrated throughout instruction)
 - b) Emergency procedures
6. **Species of Common Commercial Fish**
 - a) Identification
 - b) Use
7. **Care and Handling of Fish**
 - a) Federal and state regulations
 - b) Icing
 - c) Loading and unloading techniques

8. Types of Fishing Gear

- a) Purse seine
- b) Otter trawl
- c) Gillnet
- d) Trolling and tuna fishing
- e) Reefnet
- f) Long-line (halibut fishing)
- g) Crab fishing

9. Assembling and Repairing Gear

- a) Lacing and hanging
- b) Mending web
- c) Net materials
- d) Mesh sizes

10. Marine Engines and Power Driven Equipment

- a) Starting and basic operating procedures
- b) Hydraulic units
- c) Safety rules

To obtain further information, address inquiries to:
Admissions
Bellingham Vocational-Technical Institute
3028 Lindbergh
Bellingham, WA 98225

BOSTON UNIVERSITY MARINE BIOLOGICAL LABORATORY

Woods Hole, Massachusetts 02543

The Boston University Marine Program (BUMP) is a program in marine biological sciences primarily for graduate students but open to a small number of selected advanced undergraduates. It includes the following:

Basic courses in Marine Biology presented annually during the academic year (September-May) by BUMP faculty in residence at the Marine Biological Laboratory at Woods Hole.

Seminars in Marine Biology with the participation of BUMP faculty and visiting marine scientists.

Opportunities for research and for research training in marine problems, made possible by the availability of facilities at the MBL, on campus in Boston, and at the New England Aquarium in Boston.

Opportunities for qualified graduate students and undergraduates from other institutions to take courses and seminars in BUMP on a "leave of absence" basis from their home institution with academic credit available for transfer from the Boston University Graduate School.

A 65-foot vessel, *R/V A.E. Verrill*, and the library at the MBL, among the finest marine biological libraries in the country, are available to BUMP students.

The following degrees are offered:

1. **A.M. in Biology**, specializing in marine biology, requiring eight graduate-level semester courses (32 credit hours), a reading knowledge of one major modern language (French, German or Russian), and the presentation of a master's thesis.

2. **Ph.D. in Biology**, specializing in marine biology, requiring successful completion of eight graduate-level semester courses (32 credit hours) beyond the A.M., a reading knowledge of one major modern foreign language (if not already demonstrated for the A.M.), successful completion of a qualifying examination, and presentation of a Ph.D. thesis, with an oral examination.

Exceptionally well-qualified candidates may be admitted to the Ph.D. program without the A.M. as a prerequisite. In such cases the A.M. thesis is waived.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Director

Boston University Marine Program
Marine Biological Laboratory
Woods Hole, MA 02543
(617) 540-1979

BOWDOIN COLLEGE

Brunswick, Maine 04011

Bowdoin College is a private, undergraduate liberal arts college with an enrollment of 1400 students. It maintains a Marine Research Laboratory located 11 miles from the college on a 15 acre tract of land which includes a meadow, pond, woodland, and shore frontage. The lab is equipped with running seawater, experimental tanks, two 18-foot boats, sampling gear, and a variety of analytical instruments for research. The on-going research concentrates on the fate and effects of pollutants in the marine environment. Heavy metals and petroleum are the two pollutants studied with respect to physiological stress on bivalve molluscs, diversity/density analysis of benthic and planktonic invertebrates, and effects on mangrove forests. Field work has been conducted in tropical, temperate, and arctic environments.

The Marine Research Laboratory collaborates closely with Bowdoin's Hydrocarbon Research Center (HRC) which is actively studying the response of the cytochrome P450-dependent mixed function oxidase system in fish and crabs to pollutants as well as the effect of heavy metals on bivalve molluscs. The HRC performs the chemical analysis of all water, sediment, and tissue samples as part of a close interdisciplinary effort with the Marine Research Laboratory.

No Marine Science degrees are offered at Bowdoin; however, students concentrating in biology and chemistry are able to receive credit for work in marine science. Marine related courses are offered through Bowdoin's Environmental Studies Program.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director
Marine Research Laboratory
Cleaveland Hall
Bowdoin College
Brunswick, ME 04011
(207) 725-8731 x602

BOWLING GREEN STATE UNIVERSITY

Bowling Green, Ohio 43403

Bowling Green State University offers courses in marine science within the framework of the Departments of Biological Sciences and Geology.

The Department of Biological Sciences is located in the modern Life Sciences Building which is well equipped with research and teaching instruments and facilities commensurate to a Ph.D. degree-granting department. The facilities include a sizeable marine laboratory equipped with numerous fiberglass aquaria of 10, 30, and 250 gallon capacity, refrigerated aquaria units, pH meters, precision balance, refractometer, spectrophotometer, temperature control incubators and refrigerators. Additional equipment for research projects is available in the department. The department offers a number of aquatic oriented courses including a marine closed-system course and a marine biology course with field trip. The University is affiliated with the Gulf Coast Research Laboratory, Ocean Springs, Mississippi, and with its summer courses in addition to those in the department, students can gain a background in marine biological science.

The Department of Geology offers both courses and research opportunities in the general areas of marine geology and marine paleobiology. The facilities include a research marine laboratory for conducting experiments with small organisms, as well as modern laboratories for paleontology, sedimentology, geochemistry, x-ray analysis, and electron microscopy. A summer field course in modern marine environments has been offered in the Florida Keys on demand. A foraminiferal research program concentrates on the fauna of Bermuda, Florida, and the West Indies.

The Departments of Biological Sciences and Geology offer both the B.S. and M.S. degrees with concentrations in marine science. The following degrees are offered:

1. **B.S. in Biology.** Requirements: 32 semester hours (minimum) in Biology; plus required courses: organic chemistry (biochemistry highly recommended), calculus and physics. The student may elect to do readings on marine science topics and an independent research project.

2. **B.S. in Geology.** Requirements: 38 semester hours; plus prescribed courses in mathematics, chemistry, and physics. A student may elect to specialize in paleobiology, which requires courses in biology and a senior research project.

3. **M.S. in Biology or Geology.** Requirements: 30 semester hours minimum degree program and a formal thesis.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Marine Science Coordinator
Department of Biological Sciences
Bowling Green State University
Bowling Green, Ohio 43403
(419) 372-0330

BRAZOSPORT COLLEGE

Lake Jackson, Texas 77566

The Department of Oceanic and Marine Technology has shore laboratory facilities and major equipment at Lake Jackson, Texas. Regular classrooms average 830 square feet in area and are utilized on a flexible basis; i.e., drafting classroom equipment with drafting tables and stools are utilized for navigation classes, electronic laboratory and classrooms for marine electronics, etc., contingent upon project needs and classroom/laboratory availability. Office space specifically assigned to the program is programmed at 768 square feet. Equipment in the categories of navigation, seamanship, engineering, marine electronics, scuba diving, firefighting, furniture, and reference material are available for student's use.

Students enrolled in the program receive actual experience on vessels during each semester as well as a required practicum during which a student works on a vessel for a semester. Shortly after enrollment, freshmen receive Merchant Ordinary Seaman papers from the U.S. Coast Guard permitting them to work in the marine industry. Upon completion of the sophomore year, students receive an Associate of Applied Science degree and receive reduced sea time credits to set for the Able Bodied Seaman Examination administered by the U.S. Coast Guard. Unlike many other fields, the employment outlook for persons in the offshore oil and mineral industry along the Gulf Coast is projected to be excellent. Opportunities for advancement are usually limited only by an individual's abilities and ambition.

The following degree/certificates are awarded:

1. **Associate of Applied Science, Marine Technology;** sponsored by the Oceanic and Marine Technology Department. A total of 69 credit hours are required for this two-year program.

2. Additional certificates that may be acquired during the two-year program:

- a) Loran "C"
- b) Radar
- c) Lifeboatman
- d) Open Waters Scuba
- e) First Aid and Cardiopulmonary Resuscitation (CPR)
- f) Firefighting

Curriculum offered: available in school catalog.
 Faculty appointments: available in school catalog.
 To obtain further information, address inquiries to:
 Director
 Oceanic and Marine Technology
 Brazosport College
 500 College Drive
 Lake Jackson, TX 77566
 (713) 265-6131 x254

BROWN UNIVERSITY

Providence, Rhode Island 02912

Research and training in the marine sciences is undertaken at Brown in the Department of Geological Sciences. Most work is concerned with the history and evolution of the oceans, their circulation, and climate. In addition to programs within the department, a co-operative effort in the marine sciences exists between Brown University and the Woods Hole Oceanographic Institution. As needed by individual students, cooperative programs of study and research programs operated jointly by Brown, Lamont-Doherty Geological Observatory and Oregon State University, the student has access to extensive collections of deep-sea cores.

The following degrees are offered:

1. **A.B., Sc.B., in Marine Sciences.** This is an independent concentration program that can be structured in consultation with the departmental undergraduate advisor. Courses from chemistry, biology, geology, and physics are included.

2. **M.Sc. in Geological Sciences, specializing in Marine Sciences.** Requirements: successful completion of an integrated program including a minimum of eight semester courses, no more than two of which shall be research courses, and demonstration of research capability.

3. **Ph.D. in Geological Sciences, specializing in Marine Sciences.** Requirements: successful completion of course work and original thesis research.

Curriculum offered: available in school catalog.
 Faculty appointments: available in school catalog.
 To obtain further information, address inquiries to:
 Chairman
 Department of Geological Sciences
 Brown University
 Providence, Rhode Island 02912

CALIFORNIA MARITIME ACADEMY

Vallejo, California 94590

Located on the north shore of Carquinez Strait, 25 miles from San Francisco, the California Maritime Academy was founded in 1929. It is supported by the

State of California with supplemental funds from the U.S. Maritime Administration. Co-ed, 11 months per year for four years. Enrollment: 480.

The Academy offers two curriculums. One leads to a **Bachelor of Science Degree in Nautical Industrial Technology**. The other leads to the **Bachelor of Science Degree in Marine Engineering Technology**. Graduates serve as licensed deck or engineering officers in the U.S. Merchant Marine and also in shore-based maritime industry. The curriculums are directed primarily toward preparation for service as maritime officers; however, optional concentrations are available in Marine Transportation, Marine Business Management, Maritime Specialties, Instrumentation and Automation, Ocean Technology, Ship Construction Technology and Nuclear Technology.

A special facility is the training ship, *Golden Bear*, a 7,987 gross-ton vessel which can cruise at 16 knots and serves as a "floating laboratory" during the annual two-month training cruise.

Approximate number of degree recipients each year:

1. Marine Engineering — 55
2. Nautical Science — 55

Curriculum offered: available in school catalog.
 Faculty appointments: available in school catalog.
 To obtain further information, address inquiries to:
 Director of Admissions
 California Maritime Academy
 Vallejo, CA 94590

CALIFORNIA POLYTECHNIC STATE UNIVERSITY

San Luis Obispo, California 93407

The University is located in an area which offers students of marine sciences an unequalled, unspoiled variety of marine environments including open and protected rocky coastlines, mud and sand flats, sandy beaches, dunes and estuaries — all within easy driving distance from the campus. A recirculating sea-water system is maintained in the teaching laboratory, student research laboratory and faculty office-preparation room complex in the Science North building. A boat and gear storage building is adjacent, housing 17-foot and 14-foot outboard dories with trailers, overhead crane, net drying racks and gear storage lockers. Fishing boats at Morro Bay and Port San Luis are available for charter for open-water work. An extensive algal collection inventory of up-to-date scientific and photographic equipment is available for both undergraduate and graduate student research. The University computer facilities are also available for student use.

The following degrees are offered:

1. **B.S. in Biological Sciences** with a concentration in Marine Biology.
2. **M.S. in Biological Sciences** with an emphasis in Marine Biology.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Head

Biological Sciences Department
California Polytechnic State University
San Luis Obispo, CA 93407

CALIFORNIA STATE COLLEGE, STANISLAUS

Turlock, California 95380

The Department of Biological Sciences at California State College, Stanislaus (CSCS) offers a marine biology concentration within the B.A. or B.S. in Biological Sciences. One requirement for completion of this concentration is to take a semester of classes at a marine station, usually at Moss Landing Marine Laboratories. Requirements for the degree, including the concentration, can be found in the current CSCS catalog.

In conjunction with Moss Land Marine Laboratory, CSCS offers a Masters of Science in Marine Science degree, with a concentration in marine biology. Prospective students should apply to the Admissions and Records Office, CSCS for graduate standing and to the Department of Biological Sciences for specific requirements for this program. A description of the Master of Science in Marine Science program can be found in the current CSCS catalog.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Marine Biology Advisor
Department of Biological Sciences
California State College, Stanislaus
Turlock, CA 95380
(209) 667-3467

CALIFORNIA STATE UNIVERSITY MOSS LANDING MARINE LABORATORIES

Moss Landing, California 95039

Moss Landing Marine Laboratories (MLML) is operated by a consortium of six of the California State University campuses (CSU Fresno, Hayward, Sacramento, San Francisco State University, San Jose State University, and CSC Stanislaus) as a field station for upper division and graduate level education and research in the marine sciences. An average of 40 units of course work, plus master's research and thesis, are provided fall and spring semesters. MLML faces west on Mon-

terey Bay at the head of the Monterey Submarine Canyon, the largest such canyon on the west coast of the Americas. To the east, Moss Landing Harbor opens upon the diversified intertidal marsh and mudflat habitats of Elkhorn Slough. The buildings provide 14,000 square feet of classroom, research, laboratory, office and library space, equipped to support the diversified curriculum research needs of a multi-disciplinary operation. Skiffs and small boats (8-24') provide access to the near-shore marine and estuarine environments upon which MLML focuses primary instructional and research emphasis. An 80' oceanographic research vessel, on contract from the National Science Foundation, is used for deeper water instruction and research work on the continental shelf.

Since MLML is an integral part of six separate supporting institutions, degrees are earned through those schools. Baccalaureate and Master's degrees in the basic sciences (e.g., biology, chemistry, geology) may include marine concentrations, with one or more semesters of study at the Laboratories. While details differ in the six institutions, the following general notes apply:

1. B.A. or B.S. in Biology, Botany, or Zoology

Marine science requirements at MLML include general oceanography, marine science techniques, marine ecology, and quantitative marine science, plus electives appropriate to the major interest. In the California State Universities, a minimum of 124 units are required for the Bachelor's degree, of which 45 must be in broad general education areas.

2. B.A. or B.S. in Geology

The marine sciences concentration will be similar to that for biology with recommended electives including marine biogenic sedimentation, geological oceanography, and coastal geomorphology.

3. M.A. or M.S. in Biology, Chemistry, Geology, or Marine Sciences

Thirty graduate units, to include 8-12 units of required core courses, research and thesis units, are required for the Master's degree. The marine concentration usually includes a full year or more of work at MLML, with research and thesis on a marine environmental topic.

MLML's curriculum supports three primary disciplines: Marine Biology, Marine Geology, and Oceanography for all six participating consortium campuses. Special summer workshops and year-round seminar courses are occasionally offered for in-service marine science instruction of teachers at all levels.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director
Moss Landing Marine Laboratories
P.O. Box 223
Moss Landing, CA 95039

CALIFORNIA STATE UNIVERSITY SOUTHERN CALIFORNIA OCEAN STUDIES CONSORTIUM

Long Beach, California 90840

Six California State Universities (Dominguez Hills, Fullerton, Long Beach, Los Angeles, Northridge, Pomona) have joined to provide an educational and research outlet for their growing marine programs. Presently the Southern California Ocean Studies Consortium (SCOSC) has administrative offices on the campus at California State University, Long Beach. Future plans call for facilities to be housed in a 15,000 square foot building along the waterfront in the Long Beach/Los Angeles area. Facilities will include laboratories with running seawater, constant temperature rooms, lecture rooms, and offices.

SCOSC owns and operates the 50-foot vessel, *R/V Nautilus*, a converted purse seiner with a range of 1,000 miles. The vessel is equipped with an Omega Navigator, radio/telephone, fathometer, oceanographic winch with 3,000 feet of cable, otter trawl, Isaacs-Kidd midwater trawl, plankton nets, dredges, corers, reversing thermometers, bathythermographs, water quality monitoring systems, Nansen bottles, dissecting microscope, Secchi Disk, Avon inflatable boat, scuba equipment and diving platform. In addition, the Consortium operates several small boats.

SCOSC is supportive to each member campus. Degrees are granted through the individual campuses. Degrees available at member institutions include:

Dominguez Hills

- B.A. — Biological Science
- M.A. — Biological Science
- M.S. — Environmental Studies

Fullerton

- B.A. — Biological Science, Earth Science, Engineering
- M.A. — Biology
- M.S. — Engineering, Environmental Studies

Long Beach

- B.A. — Biology
- B.S. — Marine Biology, Geology, Earth Science, Microbiology, Zoology
- M.A. — Biology
- M.S. — Geological Sciences, Microbiology

Los Angeles

- B.A. — Biology, Microbiology, Geology
- B.S. — Biology, Engineering, Geology
- M.S. — Biology, Microbiology, Engineering, Geology

Northridge

- B.A. — Biology, Earth Science
- B.S. — Geology, Engineering
- M.S. — Geology, Biology, Engineering

Pomona

- B.S. — Biology, Microbiology, Zoology, Earth Science, Engineering
 - M.S. — Biological Sciences, Engineering
- A large variety of marine-related courses are offered

in conjunction with these degree programs at each of the member State Universities. It is a major goal of the SCOSC to offer new courses at the new facility.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director, Southern California Ocean Studies Consortium

PH1-217 California State University, Long Beach
1250 Bellflower Boulevard
Long Beach, CA 90840
(213) 498-5343

CALIFORNIA STATE UNIVERSITY, FULLERTON

Fullerton, California 92634

California State University, Fullerton (CSUF), founded in 1957, is located on 225 acres in northern Orange County, approximately 35 miles southeast of Los Angeles. The University is the largest institution of higher education in rapidly-growing Orange County, currently enrolling in excess of 20,000 students. The campus is located within 30 minutes driving time of Newport Bay, an important habitat in Southern California for estuarine life, and 45-50 minutes of the rich rocky shorelines of the Irvine Coast and Laguna Beach.

The Department of Biological Science, which occupies approximately 50,000 square feet on two floors of the natural science building, offers undergraduate and graduate emphasis in Marine Biology. Additionally, the Department of Earth Science offers undergraduate coursework in Marine Geology and Oceanography. Facilities in the Department of Biological Science include several teaching and research laboratories, walk-in laboratory cold rooms, three darkrooms, two animal rooms, and a separate aquarium room. Also, electronics, wood and metal shops are available for use, as well as a greenhouse complex including outdoor ecological pens and tanks. Marine plant, invertebrate and fish collections are maintained for study. Two well-equipped 16-foot Boston Whaler vessels are utilized in teaching and research, along with a 50-foot converted fishing boat (*R/V Nautilus*), which is berthed in nearby Long Beach. Research equipment includes salinometers, oxygen analyzers, submarine photometers, pH meters, specific ion probes, spectrophotometers, liquid scintillation counters, and numerous environmental growth chambers, standard and inverted microscopes and cameras. Additionally, a large inventory of oceanographic sampling gear is available; e.g., neuston nets, otter trawl nets, seines, Isaac-Kidd midwater and Tucker trawl nets, phytoplankton and zooplankton closing nets, Niskin bacteriological samplers, biological dredges and grabs, Phleger corer, Nansen and Van Dorn bottles equipped with reversing thermometers, depth recorders, and bathythermographs.

The Department of Biological Science offers the following degrees specializing in Marine Biology:

1. **B.A. in Biological Science**, with an emphasis in Marine Biology. A total of 124 units, including general education, 38 units in biological science, and supporting coursework in physical science and mathematics are required for the undergraduate degree. At least 18 elective units in upper division courses in biological science are required.

2. **M.A. in Biological Science**, with an emphasis in Marine Biology. A total of 30 units of advisor-approved coursework, at least 15 of which must be at the graduate level, are required for the degree, along with the successful completion and oral defense of a thesis or published paper covering a research problem.

The Department of Earth Science offers undergraduate coursework leading to the B.A. Degree:

B.A. in Earth Science, with an emphasis in Earth Fluids. Students may emphasize Meteorology or Oceanography within the general field of Earth Science. Of the 124 units required for graduation, 40 are to be taken in Earth Science and 37 in related fields.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman
Department of Biological Science
California State University
Fullerton, CA 92634
(714) 773-3614

CALIFORNIA STATE UNIVERSITY, LONG BEACH

Long Beach, California 90840

California State University, Long Beach, has research facilities and teaching programs in marine science at the main campus and in cooperation with other California State Colleges and Universities, operates the Southern California Ocean Studies Consortium. A 40-foot research vessel, *Tovan*, a 50-foot purse seiner, *Nautilus*, and a number of small crafts are available for field trips and related research activities. Courses are taught on campus in several departments and research projects are also conducted in departmental laboratories. Special research facilities, e.g., current meter, salinometer, specific-ion analyzer, atomic absorption spectrometer, carbon-sulphur analyzer, electron microscopes, gas chromatographs, water quality analyzer, Niskin bottles, nets, bottom samplers, and many other types of general laboratory equipment, plus an inventory of modern electronic and acoustic systems are available.

The following degrees are offered:

1. **B.S. in Geology** with emphasis in Marine Geology, Department of Geological Sciences.

a) Mathematics	12 credits
b) Chemistry	10 credits
c) Biology	5 credits
d) Geology	69 credits
e) Physics	8 credits

2. **B.S. in Earth Science**

a) Mathematics	3 credits
b) Physics	8 credits
c) Chemistry	10 credits
d) Astronomy	3 credits
e) Biology	3 credits
f) Geology	27 credits
g) Geography	3 credits

3. **M.S. in Geology**, specialization in Marine Geology and Environmental Science (minimum of 30 semester units of credits).

4. **B.S. in Marine Biology**, Biology Department.

a) Mathematics	6 credits
b) Chemistry	13 credits
c) Physics	8 credits
d) Geology	3 credits
e) Biology	43 credits

5. **M.S. in Biology**, specialization in Marine Biology (minimum of 24 semester units of credits).

6. **B.S. in Engineering** with Ocean Engineering option, Electrical Engineering Department.

a) Chemistry	5 credits
b) Physics	8 credits
c) Geology	3 credits
d) Mechanical Engineering	18 credits
e) Electrical Engineering	34 credits
f) Ocean Engineering Electives	9 credits
g) Science Electives	3 credits
h) Engineering Electives	8 credits
i) Civil Engineering	7 credits

7. **M.S. in Engineering** with specialization in Ocean Engineering (minimum of 30 semester units of credits).

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman
Department of Geological Sciences
California State University
Long Beach, CA 90840

CALIFORNIA STATE UNIVERSITY, NORTHRIDGE

Northridge, California 91330

The campus is in the heart of the San Fernando Valley, less than a one-hour drive to the berth of the *R/V Nautilus*. The *Nautilus*, a 50-foot seiner, is equipped with A-frame and hydraulic winches, radar, Omega navigation system, and fathometer. The boat, owned and maintained by the Southern California Ocean Studies Consortium, is utilized for class-related field trips,

research grant work, and graduate student research. Research equipment includes a complete seismic profiling system, gravity corer, Peterson and Shipek grab, bathythermographs, Nansen and Niskin bottles, Martek TDC meter, as well as other physical and biological oceanographic sampling equipment and meters.

Campus facilities include three laboratories with a standard complement of equipment (fume hoods, microscopes, glassware, and chemicals), core x-ray photographic unit, a well-equipped dark room, and facilities for maintaining living marine organisms.

The following degrees are offered:

1. **B.S. in Geology.** A degree with a *possible concentration* in Oceanography.

2. **B.A. in Biology.** A degree with several areas of concentration, with a *possible minor* in Marine Biology.

3. **B.A. in Geography.** A degree with a *possible concentration* in Climatology and with a *possible minor* in Oceanography.

4. **B.A. in Earth Science.** A degree with a *possible concentration* in Oceanography, or with a *possible minor* in Oceanography.

5. A **minor program in Oceanography** is available for all baccalaureate degrees (30-32 credits).

6. **M.S. in Geology.** Thesis with *possible emphasis* in Oceanography (30 credits).

7. **M.S. in Biology.** Thesis degree with *possible emphasis* in Marine Biology (30 credits).

8. **M.S. in Geography.** Thesis degree with possible emphasis in Marine Climatology (30 credits).

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Dean

School of Science and Mathematics

California State University, Northridge

Northridge, CA 91330

(213) 885-2004

CALIFORNIA STATE UNIVERSITY, SACRAMENTO

Sacramento, California 95819

The University offers marine science courses on the Sacramento campus in the Departments of Biological Sciences and Physics-Physical Sciences (as part of the curricula in Environmental Biology and Geology, respectively). The University also participates in the operation of the Moss Landing Marine Laboratories in Moss Landing, California (on Monterey Bay), as a part of a consortium of six California State Universities described in another citation in this publication. The science departments at the University occupy a five-story building completed in 1967; the Biological Sciences Department occupies approximately one and one-half floors of space in this large building, as well as retaining the two story building occupied earlier;

these aggregate about 69,000 square feet of floor space, 45,000 in the larger building and 24,000 in the smaller. The Geology Department takes up approximately a half-story of space. Laboratories are modern and functional. The Biological Sciences Department maintains a 23-foot research inboard power cruiser and several smaller boats, and the science building has salt water facilities. The Sacramento campus is located within an hour's drive of estuarine environments and within two hour's drive of the Pacific Ocean. The University has a library of approximately 700,000 total holdings, and is strong in science and technology, as is the nearby California State Resources Library.

The following degrees are offered:

1. **B.A. in Biological Sciences.** A broad based, normal 124 semester-unit baccalaureate degree. Chemistry, Physics, Mathematics, and Statistics are required as supporting subjects. For the marine sciences specialty, certain core courses are recommended.

2. **B.S. in Biological Sciences** (Biological Conservation (Fish and Game). This is a 132 semester-unit degree, which consists of the basic biology curriculum, with the addition of certain fish and game and other conservation courses.

3. **M.A. in Biological Sciences.** Students take several required courses in biological sciences, as well as supporting courses. A thesis is required. Certain courses and the thesis research can be done at Moss Landing Marine Laboratories.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Department of Biological Sciences

California State University, Sacramento

Sacramento, CA 95819

CAPE FEAR TECHNICAL INSTITUTE

Wilmington, North Carolina 28401

Cape Fear Technical Institute's Marine Division has training and both large and small vessel docking facilities at its main campus on the Cape Fear River in downtown Wilmington, 20 miles from the Atlantic Ocean. Physical facilities include classrooms, laboratories, a photographic darkroom and faculty and staff offices in the new seven-story wing of the Malcom J. McLeod Building — in addition to classrooms, woodworking and welding shops, a net loft and an oceanographic instrument laboratory on the Alton A. Lennon floating classroom barge. The division has 15 small-craft, ranging from 12 to 26 feet, and the 85 foot *R/V Don Moore*, which is equipped with radar, radiotelephones, fathometers, scanning sonar, and LORAN C. Scientific instrumentation used in the program's classroom instruction and on training cruises includes: winches, PDR's, CTD Systems, photometers and ir-

radiameters, a sub-bottom profiling system, current meters, corers, flow meters, salinometers, D.O. analyzers, pH and specific-ion analyzer, microscopes, incubators, autoclaves, spectrophotometers, fluorometer, and atomic absorption spectrophotometer. The marine division also enjoys cooperative arrangements with the North Carolina Marine Resource Center at Fort Fisher, the North Carolina Division of Marine Fisheries Laboratory, the North Carolina Underwater Archaeology and Marine Preservation Laboratory, and the International Nickel Company's Frances L. LaQue Marine Corrosion Laboratory, all located within 20 miles of the CFTI campus.

The following degree is offered:

A.A.S. in Marine Technology. This is an ocean-oriented scientific support program designed to prepare one for vocational and technical work in all aspects of the offshore industry. Shipboard training aboard a research vessel is the most unique requirement of this program. The approach is "hands-on."

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director of Admissions

Cape Fear Technical Institute

411 N. Front Street

Wilmington, NC 28401-3993

or,

Director

Marine Division

Cape Fear Technical Institute

411 N. Front Street

Wilmington, NC 28401-3993

(919) 343-0481

CASE WESTERN RESERVE UNIVERSITY

Cleveland, Ohio 44106

The Department of Geological Sciences at Case Western Reserve University conducts research and graduate training in Paleoceanography, Isotope Paleoclimatology, Sediment-Water Interactions, and Aquatic Geochemistry. Methodologies include stable isotope ratio geochemistry, stratigraphic analysis of sediment cores, major and trace element analyses of sediments and pore waters, modelling of ocean temperature and surface climate regimes, thermodynamic and diffusional modelling of chemical transport, observational and experimental studies of animal-sediment interactions, and flume studies of sediment transport and deposition.

Major facilities housed in the Department include mass spectrometers for H, O, C, and S isotope ratios, x-ray diffractometer, a well-equipped laboratory for sediment and pore water chemical analysis, circular flume, cathode-luminescence and fluorescence microscopy, and standard equipment for sample preparation,

optical microscopy, aquaria experiments, etc. A departmentally owned power boat, scuba gear, and sampling equipment are used extensively for studies of Lake Erie. Computer terminals located in or near the Department provide access to several computational facilities on campus ranging from HP-3000 to DEC-20. Access is also readily available to an SEM unit and to equipment for x-radiography of cores.

Graduate programs leading to M.S. and Ph.D. degrees in Geological Sciences are offered. General requirement for the degrees follow guidelines of the School of Graduate Studies of Case Western Reserve University, as set forth in the University Bulletin.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Department of Geological Sciences

Case Western Reserve University

Cleveland, Ohio 44106

CATHOLIC UNIVERSITY OF AMERICA

Washington, D.C. 20017

The Institute of Ocean Science and Engineering was established at the University in 1967 to foster research and academic programs in the marine Sciences. The major areas of marine-related research are: underwater acoustics, properties of transducers, structure and physical properties of salt water, marine cables, instrumentation, fluid dynamics, soil mechanics and physical properties of water laboratories. The University has participated in a cooperative program with three local Naval laboratories since 1967. This program sponsors mutual use of research facilities and oceanographic ships.

Computer facilities include IBM 1620 and 1130 computers and a PDP-10 computer. The University is a member of the Washington Consortium of Universities and The Marine Science Consortium of Pennsylvania Colleges and Universities. The University offers undergraduate and graduate programs at its main campus in northeast Washington, D.C. and at the Delaware Bay Marine Science Center of the Marine Science Consortium in Lewes, Delaware.

The following degrees are offered in Ocean Engineering and related fields:

1. **D. Engr. or Ph.D. in Ocean Engineering** (Department of Civil and Mechanical Engineering). Candidates for the doctorate in Ocean Engineering must satisfactorily complete two years of full-time resident graduate study beyond the master's degree or its equivalent on a part-time or three-quarter time basis. Degree requirements may be summarized as follows: a major course program (a minimum of 35 credit hours beyond the bachelor's degree), 18 credit hours in a minor field (usually Mathematics) or 12 credit hours in a first minor

field and six credit hours in a second minor field, written comprehensive examinations in the major and first minor fields, a reading knowledge of one foreign language, a dissertation, and an oral defense of dissertation. Doctoral programs in Ocean Engineering are tailored to meet the needs of the individual student. Candidates may specialize in fluid or solid mechanics, heat transfer or thermodynamics, control system or underwater acoustics. All doctoral candidates in Ocean Engineering must take a minimum of nine credit hours in pure or applied Oceanography, six one-semester upper-level graduate courses in their specialty area, and acquire appropriate at-sea experience.

2. M.S.E. in Ocean Engineering (Department of Civil and Mechanical Engineering). Candidates for the degree of Master of Science in Ocean Engineering are required to satisfactorily complete one year of full-time graduate study (a minimum of 24 credit hours including research and seminars), or its equivalent on a part-time or three-quarter time basis. A comprehensive examination in the major field plus a thesis is required. There are no foreign language requirements for the M.S.E. degree.

3. D. Engr. or Ph.D. in Engineering Acoustics (Department of Civil and Mechanical Engineering). Candidates for the Doctorate in Engineering Acoustics must satisfactorily complete two years of full-time resident graduate study beyond the master's degree, or its equivalent on a part-time or three-quarter time basis. Degree requirements may be summarized as follows: a major course program (a minimum of 35 credit hours beyond the bachelor's degree), 18 credit hours in a minor field (usually Mathematics) or 12 credit hours in a first minor field and six credit hours in a second minor field, written comprehensive examinations in the major and first minor fields, a reading knowledge of one foreign language, a dissertation, and an oral defense of the dissertation.

4. M.S.E. in Engineering Acoustics (Department of Civil and Mechanical Engineering). Candidates for the degree of Master of Science in Engineering Acoustics are required to satisfactorily complete one year of full-time graduate study (a minimum of 24 credit hours including research and seminars), or its equivalent on a part-time or three-quarter time basis. A comprehensive examination in the major field plus a thesis is required. There are no foreign language requirements for the M.S.E. degree.

5. B.S.E. (Ocean Engineering Option) (Department of Civil and Mechanical Engineering). Undergraduate students in this program follow the same curriculum as other mechanical engineering students during the freshman and sophomore years. Required Ocean Engineering courses in the junior and senior year are Engineering Properties of Materials, Physical Oceanography and Dynamic Measurements. The other required courses follow the C.M.E. curriculum. Projects related to Ocean Engineering are included in the laboratory and design courses. Fifteen semester hours

of electives in the senior year may be selected from the list of Mechanical and Ocean Engineering courses at the senior and the beginning graduate level.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director

Institute of Ocean Science and Engineering

Catholic University of America

Washington, D.C. 20017

CHARLES COUNTY COMMUNITY COLLEGE

La Plata, Maryland 20646

Marine Sciences, a department of the Division of Biological Sciences, operates teaching and research facilities at Benedict, Maryland, and at the main campus in La Plata, Maryland.

The Center for Marine and Estuarine Education at Benedict is located on the Patuxent River, an arm of the Chesapeake Bay. The Benedict Center, soon to be expanded to include residence facilities, is composed of four buildings. One building has been specifically equipped for physical and chemical studies while the others are geared for biological studies. Two research vessels, the *R/V Truitt* and *R/V Menedia* are based at Benedict and used in training cruises on the Patuxent River and Chesapeake Bay.

Facilities at the main campus include an aquatics lab, diving locker with 15 complete sets of scuba gear, environmental microbiology lab, chemical instrumentation lab, analytical water chemistry lab, and data processing center equipped with an IBM 370-165 computer. Specialized water quality equipment located at the main campus includes infrared, ultraviolet, visible, and atomic absorption, spectrophotometers; gas chromatography; total carbon analyzer; and pesticide monitoring units.

The Estuarine Resources Technology (ERT) Program of the Department of Marine Sciences is designated to train personnel for all aspects of coastal zone research. Classroom and laboratory training is reinforced through practical field studies aboard the research vessels. A graduate of the ERT program will have the scientific skills to qualify for field and laboratory positions with federal or state governments or with private industry.

The ERT program is well suited for students transferring to a four-year institution as the curriculum has been designed to maximize the transfer of academic credit. In addition, the exposure to all areas of physical, chemical, and biological marine research allows the student to choose their particular field of interest early in their academic training.

An Associate of Arts degree in Estuarine Resources

Technology is granted students completing the 66-credit hour program.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director

Department of Marine Sciences

Charles County Community College

P.O. Box 910

La Plata, MD 20646

CHEYNEY STATE COLLEGE

Cheyney, Pennsylvania 19319

Cheyney State College is the only school in the Pennsylvania State College and University system that offers a baccalaureate degree in Marine Biology. The objective of the program is to bridge the gap between two-year technical school training and graduate school.

Requirements for the degree are courses in Oceanography, Marine Biology, and field experiences during summers at an approved marine facility. Electives provided for majors include Ichthyology, Marine Invertebrates, Marine Botany, Physical Geology, and research experience at nearby institutions. Related requirements are Organic Chemistry, Physiology, Physics and Statistics. Students will be advised to choose electives which will give specific preparation for graduate school or any other career objective. Students must have a minimum of 128 hours to graduate. Rosters must be signed by students' marine biology advisor. Marine Science Consortium summer experiences may be taken any summer after the freshman year.

Facilities include an instruction laboratory which is adequately supplied for maintenance of marine organisms. Majors meet periodically for informal seminars with the marine biology faculty. Graduate school opportunities are provided by affiliates.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Professor Robert Sutcliffe

Director, Marine Biology

or,

Professor John Robinson

Chairperson, Biology Department

Cheyney State College

Cheyney, PA 19319

(215) 758-2324

CITY UNIVERSITY OF NEW YORK CITY COLLEGE OF NEW YORK

New York, New York 10031

The City University Institute of Marine and Atmospheric Sciences is the focus for a program in marine

and atmospheric sciences that reaches out to many of the individual campuses of the City University of New York. The Institute is located at City College, and a 90-foot research vessel, the *R/V Atlantic Twin*, is based at Staten Island. Research facilities at City College include a weather station; laboratories specializing in microbial, planktonic, and benthic ecology; and laboratories specializing in meteorology, satellite oceanography, sedimentation and hydraulics. City College and City University maintain cooperative arrangements with the American Museum of Natural History, the Lamont-Doherty Geological Observatory, the Osborne Marine Laboratory, and other research facilities.

The following degree programs exist in conjunction with the above programs:

1. Bachelor of Science (Biology, Chemistry, Physics, Earth and Planetary Sciences). Undergraduate students major in one of the above disciplines, and may elect to take undergraduate and some graduate courses in marine and atmospheric sciences. A program in meteorology is an interdisciplinary effort of the Earth and Planetary Sciences and Physics Departments.

2. Master of Arts (Biology, Earth and Planetary Sciences). Students must complete 30 credits of an approved program of study with a grade of "B" or better, including a research thesis. Areas of specialization include Biological, Physical and Geological Oceanography and Meteorology.

3. Doctor of Philosophy. A program in Biological Oceanography is centered at City College, but course offerings and faculty advisors also exist at Lehman, Brooklyn, Queens and Hunter Colleges. Students must complete 60 credits of an approved program, including dissertation study. In addition, students must pass a written comprehensive examination centered about the thesis proposal, a proficiency examination in one foreign language, or computer, and the defense of thesis. A *Ph.D. in Physical Oceanography and Meteorology* is obtainable under the Fluid Geophysics option in Physics. The program is centered at City College. Degree requirements are generally the same as for Biological Oceanography.

A Ph.D. program in Earth and Environmental Sciences offers subprograms in hydrology, geochemistry, sedimentology, and structural geology. Degree requirements are generally the same as for Biology.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director

Institute of Marine and Atmospheric Sciences

City College of New York

Convent Avenue at 138 Street

New York, NY 10031

THE CITY UNIVERSITY OF NEW YORK QUEENS COLLEGE

Flushing, New York 11367

Queens College is a part of the City University of New York and offers a number of programs with oceanographic orientation. The College has use of institute facilities, including the 90-foot research vessel *Atlantic Twin*, a wide range of equipment for oceanographic research and dock-side laboratories at St. George, Staten Island. Research equipment at Queens College includes instruments for stable and radioisotope studies, an atomic absorption spectrometer, infrared gas analyzers, gas chromatographs and x-ray diffraction and spectrometry equipment. A wide range of other equipment for chemical, biological and geological investigations is also available in the laboratories of the college.

The following degrees are offered:

1. **B.A. and B.S. degrees** are offered in *Geology and in Environmental Science*. Students with an interest in oceanography can take appropriate advanced courses from other departments. Generally, the thrust of the program is marine geology, marine chemistry, and coastal processes.

2. The **M.A. in Geology** includes the following requirements: 30 credits of approved graduate courses, a written dissertation and oral defense, and a written comprehensive examination. Specialization in Marine Geology is possible through selection of courses and choice of thesis topic.

3. The **Ph.D. in Earth and Environmental Sciences** is offered by City University, Graduate Center. Appropriate specialization can be arranged by selection of courses and thesis topic in consultation with an advisor.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Department of Earth and Environmental Sciences

Queens College

Flushing, NY 11367

(212) 520-7267

CLARK UNIVERSITY

Worcester, Massachusetts 01610

Clark University offers graduate and undergraduate programs for those interested in the marine sciences. The programs offer a base of essential courses in marine studies and research training under the guidance of specialists in the marine environment and related fields. Participants in the marine science program at Clark University have ready access to the cooler waters north of Cape Code and the warmer waters south of it, which together provide a diversity

of physical and biological situations. Cooperative arrangements may be made for study and research at marine laboratories such as the Marine Biological Laboratory at Woods Hole, the Marine Science Center of Northeastern University at Nahant, and the Bermuda Biological Station in the mid-Atlantic.

The following degrees are offered:

1. **B.A. in Biology.**

2. **B.A. in Student-Designed Major.** In consultation with a faculty advisory committee, a student may design his or her own program of study in the marine sciences. Courses in marine sciences are available in the departments of Biology, Chemistry, Geography and Geology.

3. **M.A. in Biology.** The student must complete 8 courses, four of which may be research courses beyond the B.A. degree, that are agreed upon by the student and his or her faculty advisor. An acceptable thesis is required which the student must defend during a two-hour oral examination.

4. **Ph.D. in Biology.** The student must complete 8 courses beyond the M.A. degree and complete an acceptable thesis which must be defended during a two-hour oral examination. A reading knowledge of one foreign language is required.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Department of Biology

Clark University

Worcester, MA 01610

(617) 793-7173

CLATSOP COMMUNITY COLLEGE

Astoria, Oregon 97103

Clatsop Community College, the only two-year institution in Oregon providing comprehensive maritime technical training, has participated since 1968 in the National Sea Grant Program in cooperation with Oregon State University. The geographic location of Clatsop Community College, 12 miles from the Pacific Ocean on the Columbia River, is extremely well suited for preliminary training in seamanship, commercial fishing, and oceanographic techniques. The area provides sheltered water for training in techniques of handling instruments, plankton tows, water sampling, salinity tests, etc. Proximity to the Pacific Ocean is an important asset for training the more advanced students in oceanographic techniques as well as extensive commercial fishing practicums.

Oceanographic indoor classes are held in a specially designed facility located on the main campus. Commercial Fishing and Marine Technology indoor classes are held at the Maritime Sciences Center, located on the shores of Youngs Bay, approximately one mile

south of the main campus. Much of the laboratory work is conducted on one of the College's boats. The College operates two boats, one is 55 feet long and the other is 30 feet long. The *M/V Forerunner*, a 55-foot steel hull, commercial fishing vessel, is fully equipped with electronics, including: sonar, radar, and Loran. In addition, it is rigged for dragging, trolling (tuna and salmon), longlining and crabbing. A boom and other gear have been added to complement oceanographic research activities.

The following degrees are offered:

1. Associate in Science

- a) Ninety credits minimum of approved coursework
- b) Cumulative grade point average of 2.00 or above for all college-level work
- c) Six credits minimum of communications courses
- d) Six credits minimum of mathematics or science
- e) Six credits minimum of social science courses
- f) Required courses prescribed for specific major curriculum
- g) Attendance at Clatsop Community College at least two terms (including the last term before the Associate in Science degree is awarded)
- h) One credit physical education (unless excused)
- i) Three credits Personal Health or Advanced First Aid with cardiopulmonary resuscitation (CPR)

2. Associate in General Studies. Same requirements as Associate in Science degree, except a student does not have to complete all required courses prescribed for the specific major curriculum. Students desiring an "emphasis in" degree must complete two-thirds of the credits of required courses prescribed for that program. The following "emphasis" programs are offered:

- a) **Associate in Science, Commercial Fishing Technology**
- b) **Associate in Science, Marine Technology**
- c) **Associate in Science, Oceanographic Technology**

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director of Admissions
Clatsop Community College
16th and Jerome
Astoria, OR 97103
(503) 325-0910

CLEMSON UNIVERSITY

Clemson, South Carolina 29631

Clemson University offers programs in the College of Agricultural Sciences, the College of Sciences, and The Belle W. Baruch Forest Science Institute which is administered by the College of Forest and Recreation Resources.

The Belle W. Baruch Forest Science Institute of Clemson University sponsors research and education programs in areas related to marine science. Current research involves dune stabilization, spoils bank reclamation, flora and fauna of rice fields, fresh-water marshes, and management of maritime forests for optimum aesthetic and productive values. The Institute manages 7,500 acres encompassing all of the habitats mentioned above.

In addition to the facilities of the Belle W. Baruch Forest Science Institute at Georgetown, South Carolina, Clemson University utilizes facilities at Morehead City, North Carolina and Charleston, South Carolina through cooperation with other institutions. On the main campus, lecture and laboratory space in the areas of geology, zoology, microbiology, and biochemistry are available for teaching and research in marine science.

The Marine Resources Division of the South Carolina Wildlife and Marine Resources Department has 5,826 square feet of laboratory and office space. These facilities will be jointly used with educational institutions including library, auditorium, wet laboratory, storage, lounge and canteen, research laboratories, teaching laboratories, offices, boats and boat storage, and the *R/V Dolphin* owned and operated by this department. Clemson will utilize the lecture-laboratory room primarily in the summer. Research space for graduate students and staff are used on an irregular basis.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Dean of the Graduate School
Clemson University
Clemson, SC 29631

CLOVER PARK EDUCATION CENTER

Lakewood, Washington 98499

The Clover Park Education Center has focused on serving the commercial fishing industry of Washington by providing technical assistance and training to the people who man the nearly 10,000 fishing vessels licensed in the state.

The Center provides training on a continuing education basis through courses and seminars concerning such topics as new laws and regulations, net mending, cable splicing, net construction, hydraulics, electronic equipment operation, and maintenance of depth sounding equipment such as Loran, radar, sonar, depth recorder, plus engine maintenance and operation. Emergency first aid, accounting and income tax is also included.

To obtain further information, address inquiries to:

Director
Clover Park Education Center
4500 Steilacoom Boulevard Southwest
Tacoma, WA 98499
(206) 584-7611

COLLEGE CENTER OF THE FINGER LAKES

Corning, New York 14830

Undergraduates are able to pursue studies and research in the marine sciences and the freshwater environment at two field sites operated by this consortium. One is the College Center of the Finger Lakes (CCFL) campus on San Salvador Island, the base for field projects in the Bahamas; the second is the Finger Lakes Institute at Seneca Lake near Watkins Glen, New York. On-campus scientific resources are available to undergraduates and faculty from the CCFL members — Corning Community College, Elmira College and Hartwick College.

Courses in the Bahamas are open to undergraduates from other institutions, and faculty outside the consortium are invited to propose teaching-research projects. Colleges also contract to use campus facilities on San Salvador Island for their own field studies. An interdisciplinary curriculum is stressed, in which the marine sciences play a major role.

The CCFL campus on San Salvador Island is based on a former U.S. naval installation at Graham's Harbour, at the invitation of the Bahamian government. Facilities include dormitories for 70 students, three classroom-laboratories, a wet lab housing a circulating sea water aquarium, faculty living quarters, a complete dining facility and a library. Projects studying near-shore San Salvador waters are done aboard 18-foot outboards.

Credit for studies in the Bahamas is awarded by co-operating colleges or students may obtain credit from their home institutions. Tuition, room and board are paid to CCFL.

At the Finger Lakes Institute, studies are undertaken year-round on ice-free Seneca Lake. Academic year use is primarily for field work, and the summer for limnological field courses and courses in sailing. Field station facilities include a laboratory, dormitory for 20 people, 73-foot dock, and equipment room.

A listing of the degrees that the CCFL members award follows:

1. **A.A.S., A.S.** - Corning Community College
2. **B.A., B.S., M.Ed., A.A.S.** - Elmira College
3. **B.A., B.S.** - Hartwick College

Curriculum offered: available in school(s) catalog(s).

Faculty appointments: available in school(s) catalog(s).

To obtain further information, address inquiries to:

Executive Director

College of the Finger Lakes

Houghton House, 22 West Third Street

Corning, NY 14830

COLLEGE OF THE VIRGIN ISLANDS

St. Thomas, U.S. Virgin Islands 00801

The College of the Virgin Islands offers a B.A. in Marine Biology and plans to institute a B.S. in Marine Biology starting in Fall 1983. Approximately a dozen students are pursuing the B.A. at this time. Class size ranges from 40 in general sciences courses, through a maximum of 20 in courses required of all biology majors, down to six in optional upper class courses. Field experiences are emphasized: SCUBA training and weekly exploratory dives are offered, as are field-oriented summer courses. The Marine Science program operates three research vessels and supports various marine research programs.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director of Admissions

College of the Virgin Islands

St. Thomas, U.S.V.I. 00801

(809) 774-9200 x222

COLUMBIA UNIVERSITY THE LAMONT-DOHERTY GEOLOGICAL OBSERVATORY

Palisades, New York 10964

Graduate students in marine sciences at Columbia University normally enroll in the Department of Geological Sciences, those in marine biology enroll in the Department of Biological Sciences. Students follow a program of study based on the varied courses offered within these departments. The major research facilities for the marine sciences (along with an extensive oceanographic library and computer facilities) are located at the Lamont-Doherty Geological Observatory campus of Columbia University in Palisades, New York.

The Observatory is located in Rockland County, New York, on top of the cliffs of the Palisades sill overlooking the west bank of the Hudson River, about 15 miles north of New York City. The 150-acre estate on which it is located was originally the home of the famous botanist, John Torrey. In 1928, the property was acquired by financier Thomas W. Lamont. His country house today serves as a library for the Observatory. After Thomas Lamont's death, the estate was given to Columbia University, which designated it for use as a research center in the earth sciences in 1949. Since the Observatory grew out of the Department of Geology of Columbia University it has always maintained a strong bond with the department. The faculty members

of the department are members of the senior research staff at the Observatory, and about 85% of the department's graduate students conduct research there. Many classes are also held at the Observatory, and the University provides a shuttle-bus service to and from the Morningside Campus.

Research activities at the Observatory have as their basic objective the study of the solid earth and its oceans. Disciplines of immediate relevance are geophysics, oceanography, geology, and geochemistry, but a thorough approach is based on the fundamentals of physics, chemistry, biology, and mathematics. Specialists in major activities at the Observatory fall into the categories described below. A student usually specializes in one of them. This does not preclude the possibility of engaging in related activities not listed or in disciplines which cross the boundaries of several fields.

The degrees of B.A., M.A., M.Phil., and Ph.D. in the Geological Sciences are offered by Columbia University.

OBSERVATIONAL SEISMOLOGY: Lamont - Doherty conducts a large and vigorous research program in observational earthquake seismology and maintains six major networks of seismometers located in tectonically interesting regions of the world: Alaska, Egypt, the Caribbean, Tadjikistan and Kirgizia (USSR), and New York State. The Alaskan and Caribbean networks, together with data from the World-Wide Standard Seismograph Network (WWSSN), are used to monitor spatio-temporal changes in seismic activity along some of the major tectonic regions. Observatory scientists and researchers have also been involved in earthquake prediction, the verification of a comprehensive nuclear test ban and the development of new instruments, such as the recently completed long-base tiltmeters, tide gauges for earthquake prediction research and a fluid device to replace standard geodetic leveling. A photographic and magnetic tape library of seismograms at Lamont-Doherty contains the world's most extensive collection of basic seismic data, including the original data of the seismograph station networks operated by the Observatory and the Dominion Observatory of Canada, a variety of digital data, microfilm copies of all data from WWSSN, and the data from the major networks run by Lamont.

THEORETICAL SEISMOLOGY: Active work is in progress at Lamont in wave-propagation studies to understand the structure of the earth's interior. A general computer program using full-wave theory to construct synthetic seismograms has been developed. This and other methods for constructing synthetic seismograms can be used to study the structure of the earth's interior at different depths. Projects range from the highly theoretical to the chiefly experimental. Students are involved at all levels of research, and a large portion of the student's training in earthquake seismology comes from research activities and association with the Observatory staff.

MARINE GEOLOGY AND GEOPHYSICS: Marine geophysical investigation is carried out by the Observatory on board the research vessel the *ROBERT D. CONRAD* (208-foot, 1,370-ton Agor-3) and vessels of other laboratories or government agencies throughout the world and often in conjunction with ships and scientists of other countries. Instruments have been developed for measuring the magnetic and gravitational fields, making precision soundings, seismic-reflection and seismic-refraction determinations of the nature of the materials beneath the ocean floor, photographing the bottom, measuring light scattering at all depths, determining the flow of heat through the ocean floor, and studying the propagation of sound in the ocean. Lamont-Doherty is also an active participant in the JOIDES/IPOD deep sea drilling program. Graduate students are expected to participate in scientific programs aboard the research vessels in preparation for thesis work and as a part of their general education.

Major areas of specialization in Marine Geology and Geophysics are: Marine Seismology, Gravity and Geodesy; Marine Magnetism; Marine Geothermal Studies; Ocean Basin Stratigraphy; and Near Bottom Processes.

GEOCHEMISTRY: The active areas of geochemical research include the investigation of circulation and material transport in the oceans, estuaries, rivers and lakes using chemical and radioactive/stable isotope tracers, chemistry and chemical alterations of oceanic crust and sediments, gas exchange processes across the air-water interface, and transfer rates and mechanisms of major and trace elements in the natural and experimental sedimentary environments. In the research projects being conducted, a combination of field observations and their interpretations using mathematical models is emphasized. A number of advanced equipment including mass spectrometers, multi-channel radiation spectrometers, gas chromatographs, electron microprobe, scanning electron microscope, plasma emission spectrometers, colorimetric spectrometers, X-ray diffractometer and various types of electronic computers are available for researchers and students.

WORLD OCEAN CIRCULATION STUDIES: The physical oceanography group at Lamont-Doherty is primarily concerned with the circulation and mixing of the ocean waters. One of the more important aspects of this work deals with the heat and water flux between ocean and atmosphere, which has an influence on the atmosphere, climate, and ocean water mass renewal. Attention is largely focussed on (1) the ocean south of 30°S (the Southern Ocean); (2) the equatorial Atlantic; and (3) various smaller-scale studies, including the Agulhas current off South Africa and the coastal waters of the eastern United States.

PALEOCLIMATOLOGY/CLIMATOLOGY: The principal focus of this highly interdisciplinary area of research is on major glacial/interglacial climatic fluctu-

ations during the last million years. These include the study of frequency and phase relationship of different parts of the climatic system defined from biotic, mineralogic and chemical parameters measured in deep-sea cores. The Lamont core collection, largest in the world, is supplemented by cruises to specific areas of detailed interest. Other paleoclimatic studies based on deep sea drilling program (DSDP) cores cover the last 100 million years and include changes in sea level, bottom-water flow, and the evolution of marine plankton. Studies of modern climatology include: satellite-based analyses of snow-cover and sea-ice extent and tree-ring analyses to measure air temperature and precipitation.

ATMOSPHERIC AND SPACE SCIENCES: Studies in the atmospheric sciences include investigations of wave propagation in the atmosphere and interface phenomena among air, earth and water. Investigation of the upper atmosphere is being carried out by means of sound from natural and artificial sources including the Concorde supersonic airplane. The space science program is conducted in cooperation with the Institute of Space Studies (located near Columbia University), a theoretical research institute of the Goddard Space Flight Center, NASA.

PETROLOGY: An active research group is studying the characteristics and origins of a wide range of volcanic and plutonic igneous rocks. Techniques utilized include XRF and atomic absorption analysis for minor and trace elements, atomic absorption analysis for major elements, mass spectrometric analysis for rare earth elements, strontium and lead isotopes, electron microprobe, and x-ray diffraction analysis of mineral phases.

PALEOMAGNETIC STUDIES: Paleomagnetic studies range over the complete spectrum of research in this field. Research is concentrated in the magnetic stratigraphy of sediments, both on land and in the world ocean; this research contributes toward an understanding of the evolutionary history of marine and terrestrial organisms and toward unraveling the climatic record of the earth during the past five million years.

POLAR STUDIES: The problems of marine geophysics and geology are being explored in the Arctic and Antarctic with techniques adapted from operations in other oceans. Certain aspects of the polar seas, such as their floating ice cover, their intense magnetic activity, and their importance in climatic changes make them of special interest to students of oceanography, geophysics, and paleoclimatology. A continuing investigation of the Arctic Ocean is being carried out by staff and graduate students on floating ice research stations.

STRATIGRAPHY AND STRUCTURAL GEOLOGY: Graduate students at Lamont-Doherty have an unusual opportunity to study the nature and origin of geologic structures. The backgrounds and interests of staff members facilitate attempts to understand the relations of mountain building processes to ocean floor tectonics, and the origin of ancient mountain belts in terms of recent and current tectonic activity.

BIOLOGICAL OCEANOGRAPHY: Research is conducted in both coastal and open-ocean biological oceanography in many areas of the world, with concentration on phytoplankton ecology, marine microbiology, benthic ecology and zooplankton ecology.

TECTONOPHYSICS: The study of tectonophysics has as its goal an understanding of the fundamental physical processes that govern the deformation of rock and the manifestation of those processes in the various deformations within the solid part of the earth. At Lamont-Doherty, the tectonophysics program is concerned largely with the deformational properties of the lithosphere of the earth.

The basic courses in marine sciences are offered by the Department of Geological Sciences. The exact curriculum to be followed by each student depends on his field of specialization and is decided upon by the student and his advisor. Other relevant courses are offered in the Departments of Physics, Chemistry, Biological Sciences and in the School of Engineering and Applied Science.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to
Director

Lamont-Doherty Geological Observatory of
Columbia University
Palisades, NY 10964
(914) 359-2900

or,

Graduate School of Arts and Sciences
Office of Admissions and Financial Aid
106 Low Memorial Library
Columbia University
New York, NY 10027
(212) 280-3808

CORNELL UNIVERSITY

Ithaca, New York 14853

There are many disciplines and courses at Cornell University that can prepare students for both general understanding and careers in various areas of aquatic and marine studies. The programs encompass basic and applied studies in the College of Agriculture and Life Sciences, Arts and Sciences, Engineering, and Veterinary Medicine. Departments and Divisions offering work in aquatic studies include: Agronomy, Avian and Aquatic Animal Medicine, Biological Sciences, Entomology and Limnology, Food Science, Geological Sciences, Natural Resources, and Nutritional Sciences. Inter-departmental coordination is provided through several multidisciplinary programs including the Aquaculture Program, Aquatic Sciences, Environmental Studies Program, and the Center for Environmental Research.

Facilities on or adjacent to the main campus include fully equipped laboratories for studies in aquatic medicine, aquatic plants, fish biology, fishery sciences, limnology, phycology, aquatic entomology, ichthyology, aquatic microbiology, invertebrate zoology, fish nutrition, environmental engineering, sanitary engineering, hydraulics, eutrophication, and water pollution. Support facilities in the form of library holdings, computer facilities, radiobiology facilities, water quality analysis services, and disease diagnostic services are extensive and readily available. A fishway, fish collecting facility, and spawning channel on Cayuga Lake, operated by the New York State Department of Environmental Conservation are available for research studies. Research vessels, the *J.G. Needham* and the *Maritime*, plus several small vessels are available for studies on Cayuga Lake. Approximately 100 small ponds designed for research studies are located near campus. The Cornell area has large aquifers of ground water available, a Fishery Laboratory, including wet labs; a radiation laboratory; a larval fish building and ponds; and the Munz Laboratory on Cayuga Lake. The ichthyology collection at Langmuir Laboratory is an especially complete collection of freshwater fishes from the north-eastern United States.

Cornell University, in cooperation with the Sea Education Association, State University of New York, and the University of New Hampshire, operates the Shoals Marine Laboratory on Appledore Island, the largest of the Isles of Shoals, located 10 miles offshore from Portsmouth, New Hampshire. Facilities include two teaching laboratories equipped with running sea water, a dormitory, and a commons building. The laboratory is served by the 100-foot ferry *Viking Queen*, the 45-foot research vessel, *Jere A. Chase*, the 35-foot research vessel, *Wrack*, the 20-foot diesel launch, *Scomber*, the 22-foot sloop, *Minnow*, and several smaller vessels. Summer courses are offered in marine science and in nautical science.

Also offered through the Shoals Laboratory and the Sea Education Association is a semester-length sequence of courses designed to provide college undergraduates with a thorough academic, scientific and practical understanding of the sea. Repeated approximately every two months, the 12-week sequence is comprised of a shore component (six weeks at Woods Hole, Massachusetts) and a sea component (six weeks aboard the *R/V Westward*). While at Woods Hole, students receive instruction in marine and nautical science and study the relationship of man with the sea. Enrollment is open to men and women judged capable of benefitting from SEA Semester, and no specific prior training or study is required.

A freshwater biological station, equipped for fisheries and limnological studies, is located at Shackelton Point on Oneida Lake. The laboratory has one and one-half miles of shoreline, 400 acres of land, fully-equipped laboratories, dormitories, and extensive field equipment including research vessels of various sizes

up to 35 feet. The station provides a full-year research program and a summer teaching program in aquatic ecology.

Cornell University and the State University of New York are partners in the New York Sea Grant Institute, New York's Sea Grant College, and conduct a broad program of research and extension on coastal problems through the Institute.

The Tunison Laboratory of Fish Nutrition at Cortland, New York, conducts studies on salmonid nutrition and related fish cultural problems. The Laboratory operates under a cooperative agreement between the U.S. Fish and Wildlife Service and Cornell University. The New York Cooperative Fishery Research Unit, located on campus at Ithaca, also operates under a cooperative agreement among the U.S. Fish and Wildlife Service, Cornell University, and the New York State Department of Environmental Conservation.

Educational programs at Cornell University emphasize maximum flexibility and freedom of choice for the student. Specific programs of study are developed by the student in consultation with his advisor—or Special Committee, in the case of graduate students. General degree requirements are kept to a minimum in order to provide the desired flexibility. Individual departments and advisors may, however, develop suggested programs within their areas of specialization. Undergraduate students must complete 120 credits with at least a C— average, and generally maintain eight terms in residence. Marine or aquatic programs are generally developed with advisors in the Division of Biological Sciences or the Department of Natural Resources.

At graduate level, major and minor thesis areas are available in the following programs: botany (phycology); ecology and evolutionary biology (aquatic ecology); limnology; marine biology; oceanography; community and ecosystem ecology; paleo-ecology; vertebrate zoology, including herpetology and ichthyology); entomology and limnology (limnology); food science (aquatic microbiology); microbiology (aquatic microbiology); natural resources (aquaculture, aquatic ecology, fishery management, fishery science); nutritional sciences (fish nutrition, fish technology); veterinary medicine (fish and shellfish pathology); biochemical engineering; environmental systems engineering; hydraulic-hydrology; and sanitary engineering. Two terms in residence are normally required for the master's degree program and six terms in residence (previous graduate study may be counted) for the doctoral program.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Field Representative

Field of Water Resources

223 Hollister Hall

Cornell University

Ithaca, NY 14853

DOWLING COLLEGE
Oakdale, Long Island, New York 11769

Dowling College offers a comprehensive selection of marine science courses affording students flexibility in meeting career objectives and interests. Students are encouraged to combine studies in a minor, such as computer science, business management, education, etc., with their concentration in Marine Sciences. Courses combine practice with theory, and field and laboratory experiences are stressed.

Dowling College is located on the south shore of Long Island with direct access to Great South Bay and the Atlantic Ocean. A wide variety of marine environments comprising the coastal zone and adjacent continental margin are readily accessible for study and research. The *R/V Dolphin*, a diesel-powered, 40-foot, ocean-going vessel, owned and operated by the College, is used extensively for class instruction and research. Shipboard equipment includes an A-frame and galleys; hydrographic winch with double drum and double capstan; stainless steel hydrographic wire; recording echo sounders; in situ salinometers, temperature meters, depth recorder, conductivity meters, and dissolved oxygen meter; water sampling bottles; reversing thermometers; current meters, a variety of bottom sediment grab samplers; plankton nets with flow meters; otter trawl; mid-water trawl; and bottom biology trawl. Navigation equipment includes Loran-C receivers, Sperry radar, radio direction finder, automatic pilot, and radio-telephone. The vessel has a diving platform, and scuba diving and underwater photographic equipment. Several small boats powered by outboard engines are available for estuarine and shallow water investigation.

Physical facilities include 11 laboratories and two walk-in cold rooms with aquarium tanks. Laboratory equipment includes two large seawater tanks, Technicon autoanalyzer, Beckman atomic absorption spectrophotometer, infrared spectrophotometer, gas chromatograph, specific-ion meter, ro-tap sieve shaker, and 10-foot wave tank.

A marine field station and laboratory located on an island at the eastern end of Long Island Sound serves as a base of operations for intensive summer field courses and scuba diving instruction.

The following degrees are offered:

1. **B.A. in Biology** with concentration in Marine Biology. Requires 35 credits in Biology.

2. **B.A. in Natural Sciences and Mathematics** with concentration in Marine Sciences. Requires 25 credits in Marine Science and a total of 25 credits in two other disciplines within the Natural Sciences and Mathematics Division.

NOTE: A proposal to offer a B.A. degree in Marine Studies has been submitted to the New York State Education Department for approval.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director, Marine Sciences
Dowling College
Oakdale, Long Island, NY 11769
(516) 589-6100

DRAKE UNIVERSITY
Des Moines, Iowa 50311

The Science Division of the College of Liberal Arts, in cooperation with Southampton College (New York), offers three undergraduate degree programs in the marine sciences. These degree programs combine elements of existing biology, chemistry and earth science majors, offered at Drake, with marine science courses appropriate to those majors that are offered by Southampton College.

The principle teaching and research facilities in the marine sciences are located at Southampton College, Southampton, New York, 11968. (Southampton College is a division of Long Island University.) The campus is located on the south shore of Long Island; vessels operated by the College's Marine Science Center have direct access to Shinnecock and Peconic Bays and the Atlantic Ocean. A complete description of facilities and equipment is given under the Southampton College entry.

The following degrees are offered: (NOTE: In every case, students will transfer to Southampton, typically for one semester and a summer session. It is expected that the transfer will usually occur for the spring semester of the junior year. Students return to Drake for the senior year.)

1. **B.A. in Marine Science/Biology**

a) Related coursework taken at Drake:

Biology	29 credits
Chemistry	20 credits
Mathematics	8 credits
Physics	8 credits

b) Coursework taken at Southampton:

Biology and Marine Science	22 credits
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2. **B.A. in Marine Science/Chemistry**

a) Related coursework taken at Drake:

Chemistry	34 credits
Biology	11 credits
Mathematics	12 credits
Physics	8 credits
Geology	4 credits

b) Coursework taken at Southampton:

Geology and Marine Science	22 credits
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3. **B.A. in Marine Science/Earth Science**

a) Related coursework taken at Drake:

Geology and Geography	28 credits
Chemistry	12 credits
Physics	8 credits
Mathematics	4 credits

b) Related coursework taken at Southampton:
Geology and Marine Science 22 credits
Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman
Department of Geology
Drake University
Des Moines, IA 50311

DUKE UNIVERSITY

Durham, North Carolina 27706

The Duke University Marine Laboratory (DUML) at Beaufort, North Carolina, is an interdepartmental and interuniversity facility for training and research in the marine sciences. It is open throughout the year with an academic and technical staff in residence. It presently occupies 15 acres on the southern portion of Pivers Island near Beaufort; the U.S. Department of Commerce, NOAA, National Marine Fisheries Service, and the Center for Menhaden Research are located on the remainder of the island.

The physical plant consists of twenty-four buildings including five dormitories, a large dining hall, one residence, boathouse, storehouse for ship's gear, classroom laboratories, seven research buildings, and a maintenance complex. The research laboratories and five dormitories are heated, and three dormitories are air conditioned, thereby providing favorable conditions for year-round research.

The station operates a well-equipped 118-foot research vessel, the *Eastward*, for training and research in oceanography, a 67-foot, steel-hull trawler, the *John de Wolf* for shelf research, a 55-foot trawler for inshore and sound investigations and a 39-foot cabin power boat for trawling and dredging in the shallower portions of the estuary. Also available are a number of small power boats and rowboats with outboard motors and collecting gear, including dredges, bottom grabs, water sampler, coring devices, salinometers and fluorometers. The DUML library receives 155 current periodicals and is complemented by the added holdings of the NOAA library and the library of the University of North Carolina Institute of Marine Sciences, located in the Beaufort-Morehead City area. An auditorium provides seating for 280 people plus smaller conference rooms. A stack area and a reading room are available.

Separate degrees are not offered in the marine sciences, but a student may pursue work for the **A.M. and Ph.D. degrees in biochemistry, botany, chemistry, physiology and zoology**. For the **A.M. degree in geology**, coursework may be taken and a thesis written in marine geology or geological oceanography. A **B.S. in geology** is offered with a curriculum preparatory to advanced studies in oceanography.

In botany the student's graduate program is planned to provide broad basic training in various fields of botany, plus intensive specialization in the field of the research problem. Graduate courses in the Department of Geology are designed to provide training in the field of sedimentary geology and micropaleontology. Areas of specialization in thesis research include continental shelf sedimentation, deep-sea sedimentation, micropaleontology of deep-sea sediments and carbonate sedimentation.

Required work for the **A.M. degree in zoology** ordinarily includes 12 units of advanced coursework in zoology, six units of coursework in a minor department and an additional six units of advanced work in a major or minor department or in other pertinent departments. Furthermore, an acceptable thesis is necessary for the fulfillment of the degree requirements.

Normally the degree program for the Ph.D. includes graduate courses in biochemistry, botany, physiology, and zoology, courses in the minor subject, wide reading in science in general and in biology in particular, research and a dissertation based on original work. Minor work is also available in the same fields plus anatomy, chemistry, geology, physics and engineering.

A graduate student working for the Ph.D. degree usually takes coursework on the main Durham campus in that particular department during the academic year and then goes to the marine laboratory for more specialized courses during the summer. By the end of the second year, he or she is expected to have passed an oral preliminary examination in his department. Thereafter, the student is free to do thesis research without further course requirements on the Durham and/or the DUML campus.

Training in the marine sciences at Duke University and at the Duke University Marine Laboratory is at the senior-graduate level in the Departments of Botany, Geology and Zoology, with the exception of the undergraduate spring term in the marine sciences which accepts students who have completed the sophomore requirements. Students are free to elect courses in any of the science departments including those in the School of Medicine and Engineering. Research and courses exist in the School of Engineering in the areas of communication theory, stochastic information processing, decision theory, digital computer systems, ocean structures and coastal formations. The undergraduate spring term provides students at the junior or senior level to spend an entire spring term at the marine laboratory, taking two courses, one seminar and one independent research program supervised by one of the resident staff.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director
Duke University Marine Laboratory
Beaufort, NC 28516

EAST CAROLINA UNIVERSITY

Greenville, North Carolina 27834

East Carolina University offers an undergraduate program in Coastal Marine Studies. This multidisciplinary program is designed to broaden students' perspective and understanding of coastal and marine resources beyond that normally provided within the students' own discipline. The program is organized around a small number of multidisciplinary courses that form the core of the program. This core is supplemented by a larger assemblage of courses from various academic departments of the University. Degrees specifically designated as ocean sciences are not offered. Students may elect to minor in Coastal Marine Studies, or take coastal marine courses as electives.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director

Institute for Coastal and Marine Resources

East Carolina University

Greenville, NC 27834

(919) 757-6779

EASTERN ILLINOIS UNIVERSITY

Charleston, Illinois 61920

Eastern Illinois University offers **B.S. and M.S. degrees in Environmental Biology**, with emphasis (among other areas) in aquatic biology, fisheries, and ichthyology. While not strictly a marine curriculum, the programs have marine applications and provide sound biological background for the students interested in marine work. The B.S. degree requires 120 semester hours, and the M.S. degree requires 32 hours beyond the baccalaureate degree. The M.S. has either a thesis option or internship option.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director of Environmental Programs

Eastern Illinois University

Life Sciences Building

Charleston, IL 61920

EASTERN KENTUCKY UNIVERSITY

Richmond, Kentucky 40475

Eastern Kentucky University is a regional coeducational public institution of higher education which provides programs of study at both the undergraduate and graduate levels and currently has an enrollment of more than 14,000. Located in historic Richmond, a

city of 21,000 and near the heart of the Bluegrass Region and Appalachian Mountains, the University is readily accessible from major or interstate highways.

The Program of Study: Fisheries Management includes basic courses in botany, zoology, physiology, genetics, morphology, ichthyology and fisheries biology courses and supporting courses in chemistry, physics and mathematics to meet the requirements for a Bachelor of Science degree. In keeping with the philosophy that a scientist must be educated as well as trained, the general education courses in English, humanities and social studies are strongly emphasized in this program. The Fisheries Management Program, having a strong emphasis in the basic biology courses and aquatic biology, and being strongly based in chemistry, physics and mathematics, prepares students for advanced studies in marine biology and oceanography.

The facilities consigned to the department are relatively new, consisting of ample classroom and laboratory units and research modules which are fully equipped. The Fisheries Management Program has specifically available a large fisheries biology laboratory, a room for aquatics and specimen room housing representative genera and species of fishes. The equipment available to support the Fisheries Management Program include the typical ones: boats, seining, collecting and capture devices, field recorders and probes, field pH meters, temperature measuring devices, telemetry equipment, oxygen analyzers and support equipment such as spectrophotometers, centrifuges, liquid scintillation counter, environmental chambers and other specialized equipment for research.

For course instruction and student research projects in the Fisheries Management Program, which require an "out-of-doors" laboratory setting, the department has available several thousand acres of land, through the University's Division of Natural Areas. The variety of habitats of streams and rivers, both in the Bluegrass region and Appalachian Mountains, provide ample environmental resources for fisheries management practice. Additional opportunities for specialized studies in fisheries biology, at the undergraduate and graduate levels, are available through the University's affiliation with the Gulf Coast Research Laboratory, Ocean Springs, Mississippi, and Tech Aqua Biological Station, Cookeville, Tennessee.

The following degrees are offered:

1. B.S. in Fisheries Management

- | | |
|----------------|---------------|
| a) Biology | 58-59 credits |
| b) Chemistry | 26-27 credits |
| c) Mathematics | 3-5 credits |
| d) Statistics | 3 credits |
| e) Physics | 10 credits |

2. M.S. in Biological Sciences. A planned curriculum of study, based on individual needs, is selected by the student in consultation with the student's graduate committee. Course work and research for thesis may be pursued which relates to fisheries management

and aquatic biology. A minimum of 30 semester hours of graduate credit is required:

- | | |
|--|----------|
| a) Biology core | 3 hours |
| b) Thesis research | 6 hours |
| c) Electives | 21 hours |
| d) One foreign language or an option
in statistics and computer science | |
| e) Written comprehensive examination | |
| f) Presentation of thesis research | |

In addition, the student may choose to pursue the Applied Ecology Option of 11 semester hours as part of their program elective hours for the M.S. degree.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director, Fisheries Management Program

Eastern Kentucky University

Richmond, KY 40475

(606) 622-2212

THE EVERGREEN STATE COLLEGE

Olympia, Washington 98505

The Evergreen State College campus has 3,000 feet of waterfront on Eld Inlet, an arm of Puget Sound. For marine studies, the main laboratory building and a residence converted to a field facility on the waterfront are used. The main laboratory building is well equipped for chemical analyses including capability for trace organic substances and trace metals. There is a variety of marine field sampling gear and field instruments for water quality measurements. The College has five small boats ranging in size from a 14-foot to a 17-foot Boston Whaler, all with outboard engines. The principle research vessel is the 38-foot motor sailer, *SEA-WULFF*.

Bachelor of Arts and Bachelor of Science degrees are offered. Evergreen's curriculum emphasizes full-time, team-taught, multidisciplinary or theme-oriented programs of studies more than single subject, part-time courses. The specific programs offered vary each year. Specialization in Marine Studies is done within the Environmental Studies curriculum.

Pending approval by the Legislature of the State of Washington, a graduate program in Environmental Studies is slated to begin in the 1984/85 school year.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director, Environmental Studies Program

The Evergreen State College

Olympia, WA 98505

(206) 866-6730

FAIRLEIGH DICKINSON UNIVERSITY

Madison, New Jersey 07940

WEST INDIES LABORATORY FAIRLEIGH DICKINSON UNIVERSITY

Christiansted, St. Croix
U.S. Virgin Islands 00820

The West Indies Laboratory is a tropical teaching and research facility of Fairleigh Dickinson University of New Jersey. It is not a degree granting part of the University although it provides support for degree programs offered in marine biology and earth sciences options in marine geology. Courses are offered at both undergraduate and graduate levels throughout the year and college credit may be transferred to other universities.

The Laboratory occupies an eight-acre tract facing coral reef-bordered Tague Bay and Buck Island Reef National Monument. The present Laboratory consists of 12 buildings, including a four-wing dormitory, dining hall, machine shop, library, four staff residences, dock-site dive locker and research laboratories, and a classroom and research laboratory building. A tertiary sewage treatment plant and auxiliary power plant are also on the site.

Although it is a teaching laboratory, it also serves as a center for tropical environmental research. Under contract with the federal government, the West Indies Laboratory operates the United States' only functional underwater habitat. The *OCEANLAB* project is committed to the exploration and harnessing of the ocean's resources for the future good of mankind. The Faile Marine Science Center, an estate recently donated to the University, supports the research efforts of the West Indies Laboratory and serves as a backup for the underwater habitat.

St. Croix is the largest of the U.S. Virgin Islands (85 square miles) and is readily reached by several major airlines with daily direct jet flights from New York and Miami. San Juan, Puerto Rico is only 45 minutes away by air and frequent daily flights are available.

The Laboratory operates under its own director and maintains a permanent resident staff including two marine biologists, a marine geologist, and various technical and maintenance personnel. The Laboratory is open during the entire year. It offers formal courses of instruction during the Summer, Fall, January and Spring periods. It also provides year-round facilities for graduate and undergraduate students and visiting investigators who wish to take advantage of specific St. Croix environments for research and special project work. University Affiliate and Visiting Group Programs are also available.

A wide variety of basic biologic and geologic laboratory and field equipment is available for use. Running sea water is pumped directly from the ocean to the Lab. Scuba facilities, eight boats and four field vehicles are maintained for scientific use. Numerous intertidal, lagoonal/shelf and shelf edge environments are readily available for study. NAUI certification is available for student and faculty wishing to develop scuba proficiency.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Office of the Director
West Indies Laboratory
Teague Bay, Christiansted
St. Croix, U.S.V.I. 00820
(809) 773-3339

or,

Coordinator
Overseas Programs Office, WIL
Fairleigh Dickinson University
Rutherford, NJ 07070
(201) 933-5000 x426

FLORIDA ATLANTIC UNIVERSITY

Boca Raton, Florida 33431

Florida Atlantic University offers ocean engineering and marine science courses at its main campus in Boca Raton, Florida. Florida Atlantic University is an upper division university (junior and senior years plus graduate work) which includes Colleges of Science and Engineering. It is a part of the State of Florida University System. Students entering FAU must have successfully completed two years at a junior college or the equivalent at a four year institution and meet the prerequisites of the department they desire to enter. Courses in the marine sciences are offered during the academic year by the departments of Biological Sciences, Geography, Geology and Ocean Engineering. Both Biological Sciences and Ocean Engineering offer regular summer and special workshop courses on the Boca Raton campus.

DEPARTMENT OF OCEAN ENGINEERING: Florida Atlantic University offers Bachelors and Masters degrees in the Department of Ocean Engineering. The University is located in Boca Raton on the southeast coast of the Florida peninsula and the Department's facilities are two miles from shore and two and one-half miles from the Florida Current (Gulf Stream). The 33-foot research vessel, *OCEANEER IV*, is operated along with numerous small crafts. Special laboratory facilities include: scanning electron microscope, wave tanks, specialized computer facilities for acoustic data analysis, anechoic chambers — wet and dry, compression tanks for depth simulation, sub-bottom acoustic profiler, side scan sonar, magnetometers, sediment analysis equipment, computer terminals with graphics capabilities, complete laboratories for metallurgy, fluid mechanics, vibrations, and ocean structural experiments. A complete dive locker with diver propulsion, wet submarines, and wireless communication equipment is maintained.

The Department of Ocean Engineering provides a comprehensive, practical curriculum in science and engineering which will prepare the student to perform

engineering tasks in the ocean environment. Graduates of this program are prepared for graduate studies in Ocean Engineering and for professional positions in industry and government.

This program requires a firm foundation in English composition and grammar, mathematics, chemistry and physics at the lower division level, plus courses in the social sciences and humanities for a balanced educational background for the engineering profession. These are provided in the pre-engineering or pre-ocean engineering (university parallel) programs of junior colleges and the lower division pre-engineering programs of most four year colleges.

The Ocean Engineering program includes integrated courses encompassing basic engineering sciences and mathematics; study of the ocean environment and its relationship to other sciences and engineering; processing of ocean engineering data; and the application of these elements to the solution of engineering problems connected with work in or on the ocean and in developing the resources of the ocean.

Emphasis is placed on the solution of problems related to working in the ocean in such areas as underwater acoustics, fluid mechanics, structures, electronics, and materials. An optional Cooperative Work-study Program is offered which provides practical experience in industry or government laboratories to students who can qualify.

The Ocean Engineering Program at FAU was designed a "State University System Program of Distinction" by the Board of Regents in October 1974. The designation was one of the five originally made throughout the entire State University System.

The following degrees are offered:

1. **M.S. in Ocean Engineering.** The Department of Ocean Engineering offers programs of graduate study leading to a Master's degree in Ocean Engineering. A thesis option requires a minimum of 45 credits of work, including a thesis, and leads to a Master of Science in Engineering degree. The non-thesis option requires a minimum of 54 credits of work and leads to a Master of Engineering degree.

Students who wish to specialize may pursue in-depth studies in the areas of marine materials and corrosion, underwater communication and acoustics, ocean structures, and hydrodynamics.

At least one-half of all graduate work must be 6000 level courses. The balance may be either undergraduate, 5000 or 6000 level as approved by the student's advisory committee. Students who enter the graduate program from undergraduate curricula which do not provide an engineering background or adequate preparation for required graduate courses will be expected to complete additional undergraduate courses for which no graduate credit may be received.

2. **B.S. in Ocean Engineering.** The Department of Ocean Engineering provides a comprehensive, practical undergraduate curriculum in science and engineering which will prepare the student to perform engineering

work in the ocean. Graduates of this program are prepared for graduate studies in Ocean Engineering and professional positions in industry and government.

As Florida Atlantic University is an upper division university, it admits students at the junior year level. The program requires a firm foundation in English composition and grammar, mathematics, chemistry and physics at the lower division level, plus courses in the social sciences and humanities for a balanced educational background for the engineering profession. These are provided in the pre-engineering or pre-ocean engineering (university parallel) programs of junior colleges and the lower division pre-engineering programs of most four year colleges.

The curricula leading to the baccalaureate degree in Ocean Engineering, both regular and cooperative programs, are accredited by the Engineers' Council for Professional Development (ECPD).

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Department of Ocean Engineering

Florida Atlantic University

Boca Raton, FL 33431

DEPARTMENT OF BIOLOGICAL SCIENCE: The Department of Biological Sciences of Florida Atlantic University, an upper-division State university, has its research and teaching facilities on the main campus in Boca Raton. The facilities are housed in the modern five-story Biological Sciences building located approximately two miles from the Florida Straits of the Atlantic Ocean, where the Gulf Stream reaches its closest point to the U.S. mainland. Research facilities for botany, ecology, ichthyology, and invertebrate zoology are located on the upper three floors of the building while laboratories for microbiology and cell biology are centered on the second floor. Facilities for transmission and scanning electron microscopy are on the first floor. Construction of an oceanside teaching and research laboratory in Boca Raton is anticipated for the near future.

The following degrees are offered:

1. **B.S. in Biological Sciences** with emphasis in Marine Biology.

a) Completion of a core curriculum of approximately 40 quarter credit hours including cell biology, Mendelian genetics, microbiology, organic chemistry, bio-organic chemistry, biochemistry, biophysical chemistry, and statistics.

b) Completion of the required emphasis courses.

c) Completion of a reading skills course in a modern foreign language.

d) Completion of a minimum of 18 out-of-college quarter credits

e) Completion of free electives for a minimum of 90 upper-division quarter credits.

2. **M.S. in Biological Sciences** with emphasis in Marine Biology.

a) A minimum of 45 quarter credits including nine for thesis research.

b) Presentation of three graduate seminars.

c) Presentation of a Master's Thesis.

d) Reading skills in French, German, or Spanish.

e) A written comprehensive examination.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Department of Biological Sciences

Florida Atlantic University

Boca Raton, FL 33431

(305) 395-5100 x2706

FLORIDA INSTITUTE OF TECHNOLOGY
Melbourne, Florida 32901

FLORIDA INSTITUTE OF TECHNOLOGY
SCHOOL OF APPLIED TECHNOLOGY
Jensen Beach, Florida 33457

DEPARTMENT OF OCEANOGRAPHY AND OCEAN ENGINEERING: The Oceanography programs combine classroom and laboratory work, at the main campus in Melbourne, with the analysis of oceanographic data collected by students using departmental research vessels and boats.

Much of the instructional work on estuarine and coastal waters is conducted as part of applied research contracts utilizing the department's small motor powered skiffs and a twin-diesel powered research boat (42-feet). Offshore work is done from larger ships (42-feet to 65-feet) owned and operated by F.I.T. These ships, located at F.I.T.'s Link Port base near Fort Pierce to the south, provide the student with access, through the Fort Pierce Inlet, to the Gulf Stream in about two hours. This route to the sea also supplies convenient access to the Bahamas and the Florida Keys. The larger ships are equipped for overnight operations and are fitted with appropriate instrumentation.

Six laboratories (Biological Oceanography, Chemical Oceanography, Geological Oceanography, Physical Oceanography, Coastal Processes and Ocean Engineering Design) are located at the main campus in Melbourne.

During the first two years the oceanography student concentrates on building a strong foundation in mathematics, physics, chemistry, biology, and humanities. The student may choose one of four options: Physical, Chemical, Biological, or Geological Oceanography. Transferring from one option to another during the first two years will incur little loss of academic credit. In all options, emphasis has been placed on a broad

scientific background for the student so that he is prepared for more advanced studies in graduate school or employment by industry or government. The department promotes the concept of applied research through a required summer shipboard program (Marine Field Projects). The program is conducted under the direction of faculty members and is designed to help the student utilize previous academic coursework in a relevant manner. The **Bachelor of Science degree** conferred through the Department of Oceanography and Ocean Engineering on the Melbourne campus is designed to prepare students to work as professional scientists and enables the individual to pursue graduate studies. Non-departmental Technician-technology oriented marine programs are offered in the School of Applied Technology on the Jensen Beach Campus for those students not pursuing a professional science-oriented curriculum.

The Ocean Engineering curriculum is designed to explore the engineering implications of man's relationship to the oceans. The first two years of study are devoted to giving the student a scientific foundation in mathematics, physics, chemistry, mechanics, and humanities. In the junior year the student will gain a knowledge of oceanographic parameters and the basics of engineering analysis. The fourth year is oriented towards the application of these basics to accomplish work in the oceans. The program requires a student to participate in an ocean engineering project. The student may schedule this requirement during the summer between the junior and senior years in the Marine Field Projects program; if necessary a limited number of students may conduct a project during the senior academic year. These student projects encourage the analysis, design, construction, installation, and operation of equipment in the ocean to a designated task.

The degree of Master of Science in Oceanography or in Ocean Engineering may be conferred upon students who have successfully completed a minimum of forty-eight quarter hours (including thesis) of required and elective work. (Applicants seeking admission information to one of the programs should have a Bachelor's degree in the related sciences from an institution acceptable to the Graduate School.) The programs offered are:

1. Bio-Environmental Oceanography
2. Chemical Oceanography
3. Geological Oceanography
4. Physical Oceanography
5. Ocean Engineering
6. Coastal Zone Management

The degree of Doctor of Philosophy in Oceanography may be taken in either of two options, Physical Oceanography or Bio-Environmental Oceanography. A student choosing one of these areas as his major field will, in addition, be expected to develop a general knowledge of the various areas of oceanography. A student who has received a Master of Science degree in mathematics, natural science, engineering, or the

equivalent preparation is eligible to apply for admission to the Ph.D. program. All applicants should have an excellent scholastic record in their Master's degree program (3.30/4.00) from an institution of acceptable academic standing. If special circumstances exist, the applicant may appeal to the Graduate Faculty for a waiver of the 3.30/4.00 requirement.

The degree of Doctor of Philosophy in Oceanography may be conferred upon students who satisfy the following requirements:

1. Successfully complete 72 credits beyond the requirements for the M.S. degree;
2. Meet the foreign language requirement;
3. Pass a comprehensive examination;
4. Complete a program of significant original research; and
5. Prepare and defend orally a dissertation concerning the research.

The program of study must be approved by the student's advisory committee and the Head of the Department of Oceanography and Ocean Engineering.

Curriculum offered: available in school catalog.

Faculty appointment: available in school catalog.

To obtain further information, address inquiries to:

Graduate Admissions
Florida Institute of Technology
Melbourne, FL 32901

or,

Head
Department of Oceanography and
Ocean Engineering
Florida Institute of Technology
Melbourne, FL 32901

DEPARTMENT OF BIOLOGICAL SCIENCES: Degrees in marine biology are offered at the *B.S., M.S., and Ph.D.* levels. Specific degree requirements and programs are described in the F.I.T. catalog. Research programs concentrate on the biology of coastal marine and estuarine invertebrates and fish, with emphasis on physiological ecology, community ecology, energetics, life history analysis, biochemistry, and reproductive biology.

Special research facilities include three boats (14 ft., 17 ft., and twin-engine 21 ft.), and field stations in Vero Beach, Florida, and Deepwater Cay, Bahamas. The department is well equipped for modern laboratory analysis including gas, infrared, and HPLC chromatography, two electron microscopes, specialized calorimeters and respirometers, and a wide range of field sampling equipment. Computation facilities include hard-wired access to VAX and PDP-11/34 minicomputers and a system of 11 microcomputers.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Department Head
Biological Sciences Department
Florida Institute of Technology
Melbourne, FL 32901
(305) 723-3701 x306

JENSEN BEACH CAMPUS: The Jensen Beach campus of the Florida Institute of Technology borders the Indian River in the town of Jensen Beach on Florida's east coast. On its 84 acres are 22 buildings, including two modern residence halls, classrooms, laboratories, shop facilities, auditorium, chapel, library, student center, swimming pool, tennis courts and athletic fields. A cafeteria, snack bar and rathskeller are open while the students are in residence. Small sailboats are located on campus for student use. The Student Center contains Student Affairs offices, Admissions, Lounges, Post Office, and exercise room. The Rathskeller contains a game room, beer and wine bar, dance floor and is the center of most student functions.

In addition to its classrooms, laboratories, and a new port facility, the school has three ocean vessels. The LCM-6, a 58-foot landing craft was acquired from the U.S. Navy and is modified to serve as a diver training vessel. She is twin-screw diesel powered and will accommodate diver trainees and instructors. The *Joie de Vivre*, a 45-foot, diesel powered vessel, is equipped with oceanographic equipment and marine electronic instrumentation and accommodates a scientific party of ten, plus the ship's crew. The *Aquarius*, a 65-foot, steel hull, diesel powered research vessel is fully equipped and designed for long-range ocean cruises and accommodates a scientific party of twelve, plus the ship's crew. The school also maintains a number of small river craft that are used for training purposes and river research projects. Among the many fine facilities located on the campus is the fully equipped Dive Complex. This facility consists of a scuba equipment dive-locker, a surface supplied diving equipment locker, maintenance and repair work areas, a swimming pool, a 20-foot deep training tank, a 15-foot deep underwater cutting and welding tank. Two recompression chambers are also located in this facility.

The degrees currently offered include:

1. **Associate of Science:** Oceanographic Technology, Marine Technology, Electronics Technology, Underwater (Commercial Diving) Technology, Petroleum Technology, Medical Technology, Photographic Technology, Diesel Technology, Marine Propulsion, Computer Technology, and Environmental Technology.

2. **Bachelor of Science:** Oceanographic Technology, Environmental-Aquaculture, Environmental Science Technology, Nursing, Computer Technology, Medical Technology, Applied Technology.

All candidates for the degree of Bachelor of Science or Associate of Science must complete the minimum course requirements as outlined in the appropriate curricula with a 2.0 cumulative average.

Approximately three quarters of the 900 students at the Jensen Beach Campus are enrolled in marine-oriented programs. Special summer programs in diving, underwater photography and marine ecology are frequently available. Certification programs in Out-

board Mechanics, Diesel Mechanics and Diving are also offered.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director of Admissions

Florida Institute of Technology

School of Applied Technology

1707 N.E. Indian River Drive

Jensen Beach, Florida 33457

(305) 334-4200 x84

FLORIDA INTERNATIONAL UNIVERSITY

Miami, Florida 33199

Florida International University is one of the newest of the nine institutions in the State University System of Florida. There are currently two campuses with a combined enrollment of over 11,000 students. Most of these are advanced undergraduates although the University has recently admitted a select group of freshman and sophomores as well. Several departments have ongoing master's degree programs.

The marine science curriculum is designed as an undergraduate certificate program. The concept of a certificate is similar to a "minor" except that it is multidisciplinary in its approach. While it is not necessary to declare a major to obtain the certificate, most students in the program are pursuing degrees in natural sciences, environmental sciences or engineering. The traditional disciplines of biology, chemistry, physics and geology are reflected in the four courses required for the certificate in marine sciences. The broad background, in turn, prepares students for work in technical fields, for advanced graduate work, or for secondary school teaching. All of these major disciplines have ongoing or beginning master's degree programs.

Florida International University (FIU) is a member of the Florida Institute of Oceanography, headquartered at the University of South Florida in St. Petersburg. FIO's 65-foot research vessel *Bellows* is available for use in conjunction with coursework and research. In conjunction with some coursework, students will spend several days at sea performing a variety of oceanographic operations.

Laboratory facilities at FIU are available for tissue culture, electron microscopy, virology and microbiology. A recirculating seawater system and radioisotope laboratory are also available. Chemistry facilities include mass, IR, NMR and UV-visible spectrometers, gas and liquid chromatographs and glass-blowing facilities. The earth sciences, physics and engineering programs have additional facilities which serve to meet the needs of students with interests in these fields.

In preparation for the certification program, two semesters of Inorganic Chemistry with a laboratory and two semesters of Biological Science with laboratory. A minimum of 18-19 credits will be required for the certificate program. Courses taken here will count toward science electives within the major as well as toward the 120 semester hours required for the bachelor's degree.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Marine Science Program Coordinator

Department of Biological Sciences

Florida International University

Tamiami Campus

Miami, FL 33199

(305) 554-2201

FLORIDA STATE UNIVERSITY

Tallahassee, Florida 32306

Florida State University is a public, coeducational institution founded in 1857. Current enrollment is over 22,400. The University has great diversity in its cultural offerings and is rich in traditions. It has outstanding science departments and excellent schools and departments in such varied areas as law, music, theater, and religion. Florida State University (FSU) is located in Tallahassee, the state capital, and is less than an hour's drive from the Gulf of Mexico.

Oceanography department headquarters, offices, and laboratories are located in the Oceanography-Statistics Building in the science area of the campus. Some of the laboratories currently in operation include water quality analysis, organic geochemistry, trace-element analysis, radiochemistry, microbial ecology, mariculture, phytoplankton ecology, numerical modeling, fluid dynamics, and more. The department also has the benefit of a fully equipped machine shop and a current-meter facility using standard current meters with modern state-of-the-art instruments. The Florida State University Marine Laboratory on the Gulf of Mexico is located at Turkey Point near Carrabelle, about 45 miles southwest of Tallahassee. The *R/V Bellows*, a 65-foot research vessel, is currently being shared by FSU and other campuses of the Florida University System.

Departmental facilities are augmented by the support received from other FSU departments and institutes, such as the Van de Graaff accelerator in the physics department, the Antarctic Marine Geology Research Facility and Core Library in the Geology Department, the Geophysical Fluid Dynamics Institute Laboratories, the Electron Microscopy Laboratory in the Biological Sciences Department, and the Statistical Consulting Center in the Statistics Department, as well

as the CDC CYBER 170/760 in the University Computing Center. The research activities of the faculty are heavily supported by federal funding, and these programs involve fieldwork, usually at sea, in all the world's oceans. Faculty and students have worked aboard a great many of the major research vessels of the U.S. fleet; because this kind of active collaboration works so well, it has not seemed necessary for the University to have its own major research vessel.

A graduate program in oceanography has existed at Florida State University since 1949, first in an interdisciplinary institute and later (since 1966) in a department within the College of Arts and Sciences. The Department of Oceanography, which offers both the *M.S. and Ph.D. degrees in oceanography*, is the center for marine studies at the University. Additional marine and environmental research is conducted by the Departments of Biological Sciences, Chemistry, Geology, Mathematics and Computer Science, Meteorology, Physics and Statics, as well as the Geophysical Fluid Dynamics Institute and the Institute of Molecular Biophysics. Both formal and informal cooperative efforts between these science departments and the Department of Oceanography have flourished for years.

The M.S. degree program requires the completion of 30 semester hours of course work and a thesis covering an original research topic. Students pursuing the *Ph.D. degree* must complete 18 semester hours of formal course work beyond the master's degree and perform original research leading to a dissertation that makes a contribution to the science of oceanography.

The first year of graduate study is generally concerned with required course work and examinations. A supervisory committee, chosen for the individual student, directs such examinations and supervises the student's progress. Under its direction, the student begins thesis research as soon as possible but no later than the fourth semester in residence. There is no foreign language requirement for either the M.S. or Ph.D.

The department currently has 39 graduate students enrolled in the program (20 M.S., 19 Ph.D.). Of these, 34 are full-time. The students come from all areas of the country, the greatest number representing the Northeast, South, and Midwest. During the last five years, there were fifty-nine M.S. and twenty Ph.D. degrees awarded in oceanography. Graduates have taken positions in federal and state agencies, universities, and private companies.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Admissions Committee

Department of Oceanography

Florida State University

Tallahassee, FL 32306

(904) 644-6700

FULLERTON COLLEGE

Fullerton, California 92634

The Fullerton College program in oceanographic technician training is a Community College (four semester two summers) program designed to prepare entry-level technicians in marine-oriented operations. The curriculum grants the *Associate in Arts degree* enabling students to transfer to senior institutions to pursue an academic rather than a vocational-technical goal.

Standard laboratory facilities and classrooms, ship time donated by local institutions and government agencies and visits to regional industrial facilities provide instructional situations. In-year and summer experiences with shipboard or on-shore work programs provide the student with actual on-the-job conditions and credits for up to eight units.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Coordinator

Oceanographic Technology Program

Fullerton College

321 East Chapman Avenue

Fullerton, CA 92634

THE GEORGE WASHINGTON UNIVERSITY

Washington, D.C. 20006

The University offers marine science courses at its main campus in downtown Washington, D.C. and at a number of off-campus facilities within easy reach of the University.

The **Bachelor of Science degree in Oceanography** is offered by and under the jurisdiction of the Columbian College, the liberal arts college of the University, and is administered by the College of General Studies. All students are required to satisfy the undergraduate requirements for the Bachelor of Science degree. In addition, specialization in oceanography is obtained by taking a minimum of 21 hours in oceanography and additional work in biology, chemistry, geology, geophysics, mathematics and physics. The students take the professional courses in oceanography at the off-campus facilities. Students attending these classes are expected to make their own arrangements for transportation. The balance are taken on-campus by fulltime students; these students participate in all normal University activities.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Program Advisor

College of General Studies

The George Washington University

706 20th Street, N.W.

Washington, D.C. 20006

SCHOOL OF ENGINEERING AND APPLIED SCIENCE:

Physical facilities include: hydromechanics laboratory (tilting bed water channel, cavitation tunnel), sedimentation laboratory, water treatment laboratory, materials science laboratory (MTS fatigue testing system, scanning electron microscope, computing facilities (HP 3000, VAX-11, computer graphics). Some thesis research is carried out at the David Taylor Ship Research and Development Center, Carderock, Maryland, and at the U.S. Corps of Engineers Coastal Engineering Research Center, Fort Belvoir, Virginia.

The Department of Civil, Mechanical and Environmental Engineering offers programs of graduate study in hydromechanics, ocean, marine and coastal engineering leading to the *Master of Science, Professional and Doctor of Science degrees*. Each program is arranged to fit a student's individual needs and interests and to utilize previous experience and background. This background should normally include an undergraduate degree in engineering, the physical sciences, or applied mathematics.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Associate Dean

School of Engineering and Applied Science

The George Washington University

Washington, D.C. 20052

(202) 676-7179

GEORGIA INSTITUTE OF TECHNOLOGY

Atlanta, Georgia 30332

MARINE SCIENCE CENTER AND SKIDAWAY INSTITUTE OF OCEANOGRAPHY

Skidaway Island, Savannah, Georgia 31406

The Georgia Institute of Technology offers programs of Marine Science and Engineering at the Marine Science Center of the University System of Georgia located on the north end of Skidaway Island. Skidaway Island covers an area of 12 square miles, including highlands, estuaries, and salt marshes, and is approximately 18 miles from downtown Savannah. It is connected to the mainland by a bridge and causeway. The open sea is eight miles away via the Wilmington River. The Center includes the University of Georgia's Marine Resources Center and the Skidaway Institute of Oceanography, a research facility of the University System.

Courses are conducted in the Marine Resources Center which has four teaching laboratories, a running seawater laboratory, lecture and conference rooms, offices, two general laboratories, educational exhibits,

and 12 large aquaria containing examples of the fauna in Georgia coastal waters. The library, located in the Skidaway Institute of Oceanography, includes over 7,000 volumes, 350 serials, and has access to the Computer Center on the University of Georgia campus at Athens.

A 32-foot (14' beam) flat-top boat, powered by twin outboard motors, and equipped for hauling shrimp nets, plankton nets, dredges, etc., is reserved for instructional purposes. Other University System boats include the 75-foot *Bluefin* and the 36-foot *Morgan J.* at Skidaway Island. The Georgia Tech School of Biology maintains a 22-foot research boat, the *R/V Thurston*, at the Skidaway Institute of Oceanography.

The following degrees are offered:

1. **M.S. in Biology** with specialization in Marine Biology.

a) Thirty-three quarter hours of approved coursework and a minimum of 17 quarter hours of thesis.

b) Completion of a thesis based upon original research.

c) A comprehensive written examination and a thesis defense.

2. **M.S. in Geophysical Sciences** with specialization in Marine Geochemistry or Marine Geology.

a) Thirty-three quarter hours of approved coursework and a minimum of 17 quarter hours of thesis.

b) Completion of a thesis based upon original research.

c) A thesis defense.

3. **Ph.D. in Geophysical Sciences** with specialization in Marine Geochemistry and Marine Geology.

a) A program of study including a major area with no specified requirements and a minor area of at least 15 quarter hours.

b) Demonstration of proficiency in a foreign language.

c) Completion of a dissertation based upon original research, generally carried out at the Skidaway Institute.

d) A comprehensive examination and a final oral defense of dissertation.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director School of Biology

or,

Director School of Geophysical Sciences

Georgia Institute of Technology

Atlanta, GA 30332

GRAYS HARBOR COLLEGE

Aberdeen, Washington, 98520

The Grays Harbor College campus is located on a hill commanding an impressive view of the cities of

Aberdeen and Hoquiam, the Grays Harbor Estuary (one of the three largest on the West Coast of the United States), and in the distance, the Pacific Ocean.

The College offers a Fisheries and Game Technician program designed to give students the skills needed to carry on field and laboratory research studies in fisheries, wildlife management, water quality and pollution control.

There is a four-acre lake on campus which drains into Grays Harbor through the Chehalis River system. A valuable asset, the lake is utilized in salmon rearing projects. In addition to Grays Harbor, the College district includes Willapa Harbor, plus hundreds of lakes, rivers, and streams in its wooded terrain which provide both study and recreational opportunities. Grays Harbor College is involved in numerous contractual research projects that employ student technicians. Equipment for student use includes two Boston Whaler boats and 50-hp. motor, three canoes, two jon boats, backpack electroshocker, beach seines, variable mesh gill nets, four salmon gravel incubators, rearing troughs, verticle incubators, floating rearing pen, and a vast assortment of biological sampling devices. Specialized water quality sampling equipment includes atomic absorption spectrophotometer, IR spectrophotometer, turbidometer, transmissometer, and several types of dissolved oxygen, salinity and pH meters. Larger 50-60-foot ocean going vessels are based through the local commercial and charter boat fleet (over 400 vessels combined) at Westport (the salmon and soon-to-be-bottom fishing capital of the U.S. located 25 miles from campus).

Grays Harbor offers a technical and professional degree program. All two-year graduates receive an Associate of Science degree. Technical graduates find employment with various state and federal agencies and private industry. Other students, following the professional track—which involves taking higher level science courses—transfer to four year institutions in pursuit of a bachelor of science degree in fisheries, wildlife management and/or environmental science.

The following degrees are offered:

1. **Associate of Applied Arts.** Ninety-three credit hours including three hours of physical education and a major in a technical field.

2. **Associate of Science.** Ninety-three credit hours including three hours of physical education and completion of a major in an approved curriculum.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director

Fish and Game Management Program

Grays Harbor College

Aberdeen, WA 98520

(206) 532-9020 x317/318

GULF COAST COMMUNITY COLLEGE

Panama City, Florida 32401

Special facilities are housed in the new Division of Mathematics and Science Building. The College borders on a large bay and has two freshwater lakes on the campus. Two new biology laboratories have just been completed. Plankton nets, beach nets, trawls, testing sampling equipment, saltwater aquarium and a Marine Technology Boat are available for collecting specimens.

The following degrees are offered:

1. **Associate of Science in Marine Technology.** This is a two-year degree. Students have two options in the sophomore year: the physical or the biological option. Students are encouraged to obtain practical field experience through the Cooperative Education courses for credit. Sixty-three semester hours are required to complete this program.

2. **Associate of Arts in Pre-Oceanography.** This program is intended to be preparation for transfer to and completion of a four-year program in oceanography. The student is required to take chemistry, physics, algebra, and trigonometry. It is recommended that the student take biology electives. Sixty-five semester hours are required to complete this program.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman, Technical Division

Gulf Coast Community College

5230 W. Highway 98

Panama City, FL 32401

(904) 769-1551, x215

GULF COAST RESEARCH LABORATORY

Ocean Springs, Mississippi 39564

The Gulf Coast Research Laboratory (GCRL) is a full-time research facility for the State of Mississippi and offers education and research in the marine sciences at both the undergraduate and graduate levels.

Located on the coast of the north central Gulf of Mexico, the Laboratory has 50 acres on its main campus in Ocean Springs, and another 21 acres in Biloxi. The main campus plant consists of modern well-equipped experimental laboratories, teaching laboratories, lecture rooms, living quarters, and maintenance shops. Nine large buildings are of brick, glass and masonry construction, air-conditioned and equipped with diesel generators for emergency electrical power. There is dormitory space for 70 students, a seven-room faculty residence, and a dining hall that serves three meals a day in summer.

The Laboratory has a permanent full-time staff of approximately 150 people, augmented in summer by visiting professors and part-time help.

A fleet of vessels used for research and teaching includes the 90-foot *R/V Tommy Munro*, the 40-foot *Hermes*, the 36-foot *Nereus* and ten power craft having 50-210 hp engines and ranging from 17 to 30 feet long, seven 14-foot skiffs and several aluminum boats under 14 feet.

OTHER FACILITIES: A research collection contains over 200,000 specimens and over 2,577 species of tropical and subtropical fishes.

A reference library devoted chiefly to the marine sciences is considered one of the finest on the north central Gulf coast.

The Laboratory operates the Marine Education Center located six miles away in Biloxi. The Center is housed in a new two-story masonry building which provides a 314 seat auditorium for various audio-visual presentations in the marine sciences, and a large aquarium room for exhibiting live specimens of marine plants and animals as a means of promoting interest in and knowledge of coastal zone life and habitats. Additionally, spaces for both research and teaching are located in this building.

Also located on the Biloxi campus is an oyster biology laboratory and a blue crab research facility. Research and teaching related to the culture of oysters, crabs, clams and other marine invertebrates are carried on here.

The campus in Biloxi also provides a 150-foot dock with deep water to serve the larger vessels.

RESEARCH EQUIPMENT: Siemens 1A electron microscope; Slee cryostat; IBM 1130 computer; LKB ultratone; atomic absorption spectrophotometer; IR spectrophotometer; two gas chromatographs for pesticide, hydrocarbon and organic analysis and equipped with interface for data computer printout; ultraviolet spectrophotometer; gasflow Geiger counter; Zeiss photomicroscope II; fully-equipped photographic laboratory; total carbon analyzer; salinometer; bathythermograph; specific ion meter; fully-equipped microbiology laboratory; electrophoresis apparatus; microfilm reader-printer; Marsh-McBriney current meter; recorder and probes; nansen bottles with reversing thermometers; Graf pan and tablet digitizer; Warburg respirometer; digimatic osometer; chloridometer; thermostatic aquaria for controlled environment studies; closed controlled habitats for holding live fish for experiments; microcomputer; Zeiss invertoscope; refrigerated heavy duty centrifuge; Beckman refrigerated ultracentrifuge; Whirlpool portable dryer; chlorine titrimeter; Beckman oxygen analyzer, three syringe pumps; Orion specific ion analyzer; Orion printer for ion analyzer; Sartorius balance (on order); STD profiler; ZBT launcher; printer for Sartorius balance; fluorescence spectrophotometer; and research pH meters.

AFFILIATED INSTITUTIONS: The Laboratory is not a degree-granting institution, but credit for courses and/or thesis research is transferred to a student's home institution.

Educational institutions affiliated with GCRL are as follows:

In State:

Alcorn State University, Lorman, MS
Belhaven College, Jackson, MS
Delta State University, Cleveland, MS
Jackson State University, Jackson, MS
Millsaps College, Jackson, MS
Mississippi College, Clinton, MS
Mississippi State University, Mississippi State, MS
Mississippi University for Women, Columbus, MS
Mississippi Valley State University, Itta Bena, MS
The University of Mississippi, University, MS
The University of Mississippi Medical Center, Jackson, MS

University of Southern Mississippi, Hattiesburg, MS
William Carey College, Hattiesburg, MS

Out-of-State:

Auburn University, Auburn, AL
The College of the Ozarks, Clarksville, AR
University of Central Arkansas, Conway, AR
Arkansas Tech University, Russellville, AR
Hendrix College, Conway, AR
University of Tampa, Tampa, FL
Berry College, Mount Berry, GA
North Central College, Naperville, IL
University of Kentucky, Lexington, KY
Morehead State University, Morehead, KY
Eastern Kentucky University, Richmond, KY
Iowa State University, Ames, IA
Wartburg College, Waverly, IA
Westmar College, LeMars, IA
St. Joseph's College, Rensselaer, IN
Louisiana State University, Baton Rouge, LA
Louisiana State University Medical Center, New Orleans, LA
McNeese State University, Lake Charles, LA
Northeast Louisiana University, Monroe, LA
Southeastern Louisiana University, Hammond, LA
Central Methodist College, Fayette, MO
Northeast Missouri State University, Kirksville, MO
Northwest Missouri State University, Maryville, MO
Southeast Missouri State University, Cape Girardau, MO
Southwest Missouri State University, Springfield, MO
Jamestown College, Jamestown, ND
Bowling Green State University, Bowling Green, OH
Southwestern Oklahoma State University, Weatherford, OK
Presbyterian College, Clinton, SC
Belmont College, Nashville, TN
Lambuth College, Jackson, TN
Memphis State University, Memphis, TN
Middle Tennessee State University, Murfreesboro, TN
Southwestern at Memphis, Memphis, TN
Tennessee Technological University, Cookeville, TN

Tennessee Wesleyan College, Athens, TN
Union University, Jackson, TN
University of Tennessee at Chattanooga, Chattanooga, TN
University of Tennessee at Martin, Martin, TN
Tennessee State University, Nashville, TN
University of Wisconsin-Eau Claire, Eau Claire, WI

COURSES OF INSTRUCTION: Some courses are offered only during the summer. Also offered the year-round are instruction and research programs leading to the M.S. and Ph.D. degrees in such areas as botany, chemistry, ecology, fisheries biology, microbiology, microscopy, morphology, parasitology, physiology, taxonomy and zoology.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

The Director's Room

Gulf Coast Research Laboratory

Ocean Springs, MS 39564

HARVARD UNIVERSITY

Cambridge, Massachusetts 02138

The program in oceanographic education at Harvard University is primarily concerned with the training of scientists who wish to prepare for careers involving the pursuit or application of knowledge of modern ocean science at its research frontiers. The underlying educational philosophy is based upon the principle that such professional oceanographic scientists must necessarily be thoroughly trained in one of the basic exact sciences in which oceanography is rooted, while at the same time made aware of the breadth of ocean sciences and the special problems of dealing with the real natural medium. It is predominantly a graduate educational program with students pursuing the regularly offered advanced degrees in the basic scientific departments of the University, but with a special oceanic orientation.

The University maintains a cross-departmental Committee on Oceanography, but teaching and research in oceanography are carried out directly in the departments of the university devoted to the basic scientific field to which a particular branch of oceanography is related. The extensive laboratories of each of the science departments are available and equipped for work in almost all branches of physics, engineering and applied physics, applied mathematics, chemistry, geology and biology. The study collections in the botanical, zoological and geological museums are extremely rich in marine material, and the library facilities are unexcelled; especially valuable in these respects is the Museum of Comparative Zoology.

Extensive computer facilities are available at the University through the Center for Research in Computing Technology, the Office for Information

Technology and via terminals directly linked to large computers elsewhere, e.g., the National Center for Atmospheric Research at Boulder, Colorado.

Of especial interest to graduate students in physical oceanography and geophysics is the Center for Earth and Planetary Physics, which consists of a group of faculty drawn from the Departments of Astronomy, Geological Sciences, and Physics, and the Division of Applied Sciences with common interest in the application of physical and mathematical methods to the investigation of large-scale natural phenomena of the earth and solar systems. Geophysics, atmospheric physics, and oceanography are all represented in the Center and interdisciplinary work is encouraged.

A fleet of sea-going ships and staff members experienced in the broad aspects of practical work at sea are available under the cooperative education program in oceanography between Harvard and the Woods Hole Oceanographic Institution. Under this program, qualified students registered for graduate work at Harvard or at the Woods Hole Oceanographic Institution have access, as appropriate, to courses of instruction, advice of staff, and use of research facilities at the other institution.

Other oceanographic facilities and courses of instruction are available through cooperative agreements with the Massachusetts Institute of Technology, the Marine Biological Laboratory at Woods Hole, the Bermuda Biological Station for Research, and the Massachusetts Department of Conservation (Division of Marine Fisheries), the U.S. Fish and Wildlife Service, and other oceanographic institutions.

The Faculty of the Committee on Oceanography at Harvard University adheres to the principle that the oceanographer should be thoroughly qualified in one of the classical scientific disciplines. His studies of the phenomena of the ocean proceed as a specialty within, or as an extension of, one of these fields of learning. As a consequence, there is no Department of Oceanography at Harvard, but members of the Committee on Oceanography will assist students who wish to prepare themselves for work in this special field. At the undergraduate level, the student is expected to arrange courses within the framework provided in the usual fields of concentration. Graduate students will ordinarily meet the requirement for the higher degrees within one of the existing divisions of the faculty, but if their programs necessarily bridge two or more established departments, their degrees may be administered by a joint committee composed of members of the departments concerned.

The following degrees are offered for studies in:

1. Biological Oceanography and Marine Biology: **M.S. (or M.A.) and Ph.D. in Biology** from the Department of Biology and **M.S. (or M.A.) and Ph.D. in Applied Physics or Applied Mathematics** from the Division of Applied Sciences. Master's granted per year, four; Ph.D.'s per year, two.

2. Chemical Oceanography and Marine Geochemistry. **M.S. (or M.A.) and Ph.D. in Applied Sciences** from the Division of Applied Sciences, or **A.M. and Ph.D. in Geophysics** from the Department of Geological Sciences. Master's granted per year, one; Ph.D.'s granted per year, one.

3. Marine Geology and Geophysics. **A.M. and Ph.D. in Geology or Geophysics** from the Department of Geological Sciences. Master's granted per year, one; Ph.D.'s granted per year, one.

4. Physical Oceanography. **M.S. (or M.A.) in Applied Sciences, Ph.D. in Applied Physics or Applied Mathematics** from the Division of Applied Sciences; **Ph.D. in Applied Mathematics** from the Committee on Applied Mathematics; **Ph.D. in Physics** from the Department of Physics. Master's granted per year, three; Ph.D.'s granted per year, two.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Chairman

Committee on Oceanography
Harvard University, Pierce Hall
29 Oxford Street
Cambridge, MA 02138
(617) 495-2819

HIGHLINE COMMUNITY COLLEGE

Midway, Washington 98031

Highline Community College offers a two-year (seven quarter) diving technology program to prepare students for employment in the offshore oil fields or in the ocean-related construction industries. The program, which leads to the *Associate in Applied Science degree*, utilizes comprehensive training in the underwater environment to give the student sufficient theoretical and practical education to obtain a starting job in the diving industry.

A diving pier on Puget Sound is owned and operated by the College as an integral part of the diving technology program. Year-round diving in open water allows the student to gain experience with contemporary diving helmets, masks, gas recirculators, and scuba gear.

The Wilson Mark IV Deep Diving System is used for training in Diver/Bell lock-outs and transfer under pressure, mixed-gas and console operations, and treatment/decompression procedures. In addition to instruction in diving, strong emphasis is placed on rigging, seamanship, ship construction, and salvage principles.

A course on blasting, with underwater application, is taught up to the level required for a state blaster's license. Students are required to obtain Lifesaving and Industrial First Aid certification as part of the course. Various engineering, welding, communications, and science courses are included in the program.

Special Admission Requirements: Before applying for admission, students must look beyond the glamour and excitement of the program to the realities of long hours of study, physical exertion and the potential hazards inherent in the undersea environment. Applicants for the diving technology program must complete a rigorous series of medical tests before they are admitted, and *basic scuba certification is pre-requisite* for entry.

Thorough screening for the program allows a maximum of 45 students to enroll for the first year and, of that number, only the top 24 are admitted to the second year. The risk factor must also be considered; water is a hostile environment — claustrophobia and temptation to panic are ever present. Students are required to carry health and accident insurance and to sign a liability waiver. Minimum age for application is 18.

Obtain College application and Diving Technician application from the Office of Admissions. Applications will be accepted December 1 through March 31 for the following Fall. Applicants will be notified of acceptance or rejection by April 30.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Admissions Office

Highline Community College

Midway, WA 98031

(206) 878-3710 x361

or,

Program Director

Highline Community College

Midway, WA 98031

HUMBOLDT STATE UNIVERSITY

Arcata, California 95521

The Marine Science Program at Humboldt State University offers instructional and research opportunities in oceanography, marine fisheries and various aspects of marine biology. The proximity of the school and the HSU Marine Laboratory to a wide variety of marine environments offers the students ample field trip opportunity both for research and classroom work. The laboratory, located at Trinidad on the Pacific Ocean, 15 miles north of the main campus, includes a lecture room, three large teaching laboratories, a large research wet laboratory, graduate research space and a shop. A modern seawater system and various types of aquaria and trays serve the needs of the staff and students. Research vessels are chartered to support the Marine Science Program. The on-campus facilities include a fish hatchery, water chemistry and ichthyology laboratories. An area including fresh water and salt water marshes and a brackish water lake is readily accessible adjacent to and in Humboldt Bay for estuarine studies. In addition, a data processing center is available for student use. Equipment, technical guidance and financial aid are provided graduate students

and some seniors through programs on marine sport fisheries conducted by the California Cooperative Fisheries Research Unit on campus.

The University offers the following degrees through the Colleges indicated:

COLLEGE OF SCIENCE/Department of Biological Sciences:

1. **Bachelor of Arts in Biology** with an option in Marine Biology. Requirements: general education (to ensure breadth in the humanities, social sciences and communications); lower division courses in mathematics, chemistry, physics, and biology; upper division requirements in general and intertidal ecology, genetics, evolution, bacteriology, physiology, invertebrate zoology, vertebrate zoology, marine phycology, general oceanography, special problems, and organic chemistry.

2. **Master of Arts in Biology.** Requirements: appropriate undergraduate degree with an overall undergraduate grade point average of 2.5 or a grade point average of 3.0 for the last ninety quarter units; seminars and either completion of an approved thesis, or an approved project; completion of 45 units selected in consultation with a graduate committee; a final oral examination.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Department of Biological Sciences

Humboldt State University

Arcata, CA 95521

(707) 826-3245

COLLEGE OF NATURAL RESOURCES/Department of Fisheries:

1. **Bachelor of Science in Fisheries.** Requirements: general education (to ensure breadth in the humanities, social sciences, and communications); lower division requirements in mathematics, chemistry, biology, physics, computer usage, statistics and technical writing; upper division requirements include courses in physiology, invertebrate zoology, fish ecology and water properties, plus 20 units of approved electives and free electives to bring total to 192 quarter units for the B.S. degree. Upper division requirements are arranged to provide for options in freshwater fisheries, marine fisheries, or aquaculture

2. **Master of Science in Fisheries.** Requirements: appropriate undergraduate degree; research topics, seminar and thesis required, plus courses up to 45 quarter units selected in consultation with a graduate committee.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Department of Fisheries

Humboldt State University

Arcata, CA 95521

(707) 826-3951

COLLEGE OF NATURAL RESOURCES/Department of Oceanography:

Bachelor of Science in Oceanography. Requirements: general education (required and elective courses to ensure cultural breadth in the humanities, social sciences, English, and speech); lower division requirements in mathematics, chemistry, physics, biology, geology, and statistics; upper division requirements (core courses plus 24 units of approved science electives); and free electives to bring the total number of units for the B.S. degree to 192 quarter units.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Chairman

Department of Oceanography

Humboldt State University

Arcata, CA 95521

(707) 826-3328

COLLEGE OF NATURAL RESOURCES/Interdisciplinary Option:

Master of Science in Natural Resources. Requirements: appropriate undergraduate degree (e.g., a natural resources discipline, a life science discipline, a physical science discipline, etc.).

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director of Graduate Studies

College of Natural Resources

Humboldt State University

Arcata, CA 95521

(707) 826-4155

THE JOHNS HOPKINS UNIVERSITY

Baltimore, Maryland 21218

The program in oceanography in the Department of Earth and Planetary Sciences at Johns Hopkins emphasizes physical oceanography, and is closely linked to the program in geophysical fluid dynamics. It also provides opportunities for exploring chemical oceanography (through the geochemistry program within the department) and marine biology (through the ecology program within the department). The department laboratories and shops are in Olin Hall, and are equipped with the general and specialized equipment required for oceanographic research. Photographic, drafting and data reduction facilities are available to the students; an extensive and active Computer Center is maintained on campus.

In addition, the resources of the Chesapeake Bay Institute, a division of the University engaged in ocean-

ographic contract research, are available to students. The C.B.I. research vessels are docked at the Institute's field laboratory in Annapolis, Maryland, about an hour's drive from campus. The fleet includes the 106-foot catamaran *R/V Ridgely Warfield*, specifically designed for research in estuarine and coastal waters, as well as several smaller vessels.

The Department has an agreement which permits students to use the facilities of the Smithsonian Institution in Washington, D.C. should this be required for their research.

The Department accepts candidates for either an M.A. or Ph.D. program. Candidates for the M.A. program in oceanography must complete a prescribed program of coursework; demonstrate a reading knowledge in French, German, or Russian; complete an essay based on original work; and pass an oral examination before a committee of the department. Candidates for the Ph.D. will take such courses and meet such requirements as deemed necessary by their advisory committee, must satisfy the Department foreign language requirement, and must pass a comprehensive examination before a committee of department faculty as well as an oral examination administered by the Graduate Board of the University, and must submit an acceptable dissertation based on original research. A year of residence at the University is required for all advanced degrees.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Chairman

Department of Earth and Planetary Sciences

The Johns Hopkins University

Baltimore, MD 21218

KUTZTOWN STATE COLLEGE

Kutztown, Pennsylvania 19530

A unique cooperative agreement between Kutztown State College and 12 other academic institutions allows Kutztown State College to offer a comprehensive Marine Science program. The Marine Science Consortium, Inc., a non-profit corporation created by the member institutions, allows them to pool their resources of facilities, instructors, and equipment. These concentrated assets have been used to establish the Wallops Island Marine Science Center adjacent to Chincoteague Bay and National Wildlife Refuge, Assateague Island, Virginia. Primary facilities include: biology laboratories, marine geology and chemistry laboratories, classrooms, library, administrative offices, cafeteria, equipment rooms, plus housing for 200 students and faculty. Extensive teaching and research facilities are available at the center for marine investigations in geology, physics, chemistry and biology. Four vessels, from 30-feet to 60-feet, are available for educational

and research purposes inshore or on the high seas. Numerous small boats are also available for projects near the station. Twenty-three separate Marine Science courses are offered each summer by the consortium which draws its teaching staff from the academic departments of the member schools.

The **B.A. degree in Marine Science** at Kutztown State College prepares students for admission to graduate schools, employment in industry, government or education. The degree is broad-based, requiring successful completion of 1½ years of mathematics, and one year each of classical college biology, chemistry and physics. Additionally, each student is required to complete one course in marine biology, marine geology, physical oceanography and/or chemical oceanography. Students are encouraged to elect five courses in one of the above interdisciplinary areas of oceanography. A senior level research project is also required. A minimum of three summer courses are required at the Marine Science Consortium, Wallops Island, Virginia.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Chairman

Physical Science Department

Kutztown, PA 19530

(215) 683-4447

LAMAR UNIVERSITY

Beaumont, Texas 77710

Lamar University, through its Department of Biology, offers interdisciplinary work leading to the degree of **Bachelor of Science in Oceanographic Technology**, with options in Marine Biology, Marine Geology, and Ocean Engineering. While most of the classroom and laboratory facilities are on the main campus in Beaumont, the field work is based on a site in Port Arthur, on Sabine Lake, which is an excellent example of a coastal or estuarine environment. Teaching and research laboratories are equipped for both instructional work and student-oriented projects.

Most of the field activity is related to coastal environmental problems and is centered at the 40,000 square foot Pleasure Island facility where geological, biological and geochemical laboratories are established. Berthing facilities lie adjacent to the Pleasure Island laboratory where the 34-foot twin engine steel catamaran, 20-foot glass inboard-outboard, and 23-foot twin outboard boats are kept. Smaller glass boats and aluminum skiffs are also available for river and shallow bay collection.

The 34-foot catamaran is rigged for shallow water coring, trawling, and dredging. Research equipment includes an induction salinometer, dissolved oxygen meter, Ekman current meter, otter and plankton trawl

nets, pH meters, atomic absorption spectrometer, x-ray diffraction, microscopes and photographic equipment.

The following degree is offered:

B.S. in Oceanographic Technology. The requirements for this degree are as follows:

1. Meet general University degree requirements.
2. Completion of 131-134 semester hours.
3. Specialization of 21-28 semester hours in Biology, Geology or Engineering option.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Dean, College of Sciences

Lamar University

P. O. Box 10022

Beaumont, TX 77710

LEHIGH UNIVERSITY

Bethlehem, Pennsylvania 18015

Lehigh University has teaching and research facilities on the main campus at Bethlehem, Pennsylvania, and at a marine field station near Stone Harbor, New Jersey. The principal research facility is the Center for Marine and Environmental Studies at the main campus, including a marine biology laboratory and a marine geology laboratory. The off-campus facility, The Wetlands Institute, is equipped with a running salt water system, a Boston Whaler with outboard motor, and an inboard skiff. Research equipment includes salinometers, spectrophotometers, pH meters, microscopes, and biological sampling apparatus. On campus there is access to major items of research equipment through academic departments and other centers including atomic absorption spectrophotometer, gas chromatography/mass spectrometer, scanning electron microscope, electron microprobe, x-ray diffractometer, and sediment size-analysis apparatus.

The following degrees are offered through the respective academic departments:

1. **M.S. in Biology**, specializing in Marine Biology.
2. **M.S. in Geological Science**, specializing in Marine Geology.
3. **M.S. in Civil Engineering**, specializing in Coastal Engineering.
4. **Ph.D. in Biology**, specializing in Marine Biology.
5. **Ph.D. in Geological Sciences**, specializing in Marine Geology.
6. **Ph.D. in Civil Engineering**, specializing in Coastal Engineering.

The minimum requirements for the master's degree include:

1. Not less than 30 semester hours of graduate work;
2. Not less than 18 hours of 400-level coursework;
3. Not less than 18 hours in the major field, of which at least 15 hours must be in 400-level courses; and
4. A thesis or a report based on a research course of at least three credit hours or no more than six

hours (Biology also requires passing a departmental qualifying examination).

The minimum requirements for the doctorate are:

1. Passing a departmental general examination;
2. Sixty credit hours beyond the master's degree based on a program of work formulated by the candidate and a special committee, including research for a dissertation;
3. Oral and written presentation of a dissertation approved by the candidate's special committee; and
4. Passing a foreign language proficiency examination.

In the past academic year there were 3 marine-related master's degrees granted in Biology, and 5 in Geological Sciences; 2 marine-related Ph.D's in Biology, and 1 in Geological Sciences.

Prospective graduate students should communicate directly with the chairman of the academic department of their choice (Biology, Civil Engineering, or Geological Sciences), as applicants must meet the requirements of, and be accepted by, the academic department in which they plan to earn an advanced degree.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director, Center for Marine
and Environmental Studies

Chandler-Ullmann #17

Lehigh University

Bethlehem, PA 18015

LONG ISLAND UNIVERSITY/ SOUTHAMPTON COLLEGE

Southampton, New York 11968

The division of Natural Sciences instructional, laboratory and research space occupies approximately 22,800 square feet which includes a one-acre campus marine station of 5,800 square feet with dockside facilities. Vessels owned and operated by the division include the *Shawna IV*, a 38-foot twin diesel research vessel which is equipped with radar, Loran, recording fathometer, s/s and CB radio, electrically driven one-ton capacity hydrographic winch with 1,000 feet of wire and a small wet laboratory. Additional research vessels include one 34-foot platform outboard powered vessel; one 30-foot sea skiff; four 19-foot and three 17-foot fiberblass utility boats. These vessels are equipped with winch, davit or A-frame and metering wheel, fathometers, and specialized sampling and collecting equipment as required for shallow water and estuarine work. Major marine laboratory instruments available include a three-channel Technico Auto-analyzer, a multichannel scintillation spectrophotometer, atomic furnace absorption spectrophotometer, anodic stripper,

gas chromatography apparatus, x-ray crystallography apparatus, a salinometer, a sediment size analyzer and a fluorometer.

The **Bachelor of Science in Marine Science** is offered with concentrations in biological, chemical or geological areas of study.

The number of marine science majors graduating in 1982 was 78. In addition to the above programs an environmental science major is offered which combines training in specific discipline and broad exposure to the social science aspects of environmental problems.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director

Marine Science Program

Southampton College

Southampton, NY 11968

(516) 283-4000, x161

LOUISIANA STATE UNIVERSITY

Baton Rouge, Louisiana 70803

Marine Sciences education in the Center for Wetland Resources (CWR) of Louisiana State University (LSU) is focused on the study, management and development of marshlands, estuaries, shallow-water environments and related resources typical of the coastal zone. The department and cooperating University organizations provide extensive aerial photograph and map collections, nuclear and computer science facilities, chemical analysis capabilities, biological and sedimentological laboratories and sampling equipment, boats and skiffs for nearshore operations, machine shops, photographic laboratories and library facilities.

Field operations in Louisiana are conducted from University-leased facilities near work sites or from those provided through cooperation with the extensive marshland refuge system operated by the Louisiana Wildlife and Fisheries Commission. A typical operations base may include living space for four to six people and a portable laboratory building. Although larger boats can be berthed at nearby marinas, most field work is conducted with boats in the 16-foot to 24-foot class.

The Center for Wetland Resources at LSU serves as the University's primary agency for research and education in the marine and wetland fields. The Center was founded in 1970 and it brought together three of the University's marine-oriented agencies: Coastal Studies Institute (CSI), Department of Marine Sciences, and Office of Sea Grant Development. Recent additions are the Laboratory for Wetland Soils and Sediments (LWSS), the Coastal Ecology Laboratory (CEL), and the Ports and Waterways Institute. In addition to

its own education, research, and advisory services, the Center is committed to the encouragement and support of activities related to coastal systems throughout the University and State.

The Coastal Studies Institute, a research organization established in 1954 with major emphasis on physical systems, has received primary and continuing funding support from the Coastal Science Program, Office of Naval Research. Its research is interdisciplinary, extending into geography, geology, geophysics, hydrodynamics, dynamical meteorology, remote sensing, and chemistry. Field investigations have been undertaken on all continents, except Antarctica, but including the coast of the Arctic Ocean. The program is field oriented, and concentrates on form-process relationships in coastal and continental-shelf environments. The emphasis of the marine geology program is on deltaic and shelf sedimentary environments and sediment transport mechanisms, including mass-movement processes. The coastal dynamics program focuses on geophysics of water and sediment movement and dynamical meteorology. An Industrial Associates Research Program supplements contractual research funds.

The Department of Marine Sciences, created in 1968, has developed masters and doctoral programs for students interested in careers involving marine-related research, technology, resource utilization and education. Although a few of the department's courses are open to undergraduates, no baccalaureate degree program is offered. Courses and curricula in the department are concerned mainly with the marsh and shallow water environments of the Louisiana coast rather than the "bluewater" courses stressed elsewhere. The academic program is augmented by a wide choice of marine-related courses taught in other departments of the University. CSI, LWSS and CEL personnel serve also as faculty members of the Department of Marine Sciences.

The Office of Sea Grant Development administers the Louisiana Sea Grant College Program, a part of the National Sea Grant Program, National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce. The Sea Grant concept uses the capabilities of many kinds of institutions, laboratories, and public and private agencies to solve the practical problems related to the development of marine and coastal resources. Three general categories of activities are called for under the Sea Grant mandate: training and education, with emphasis on providing people with the knowledge and skills necessary for the development of marine resources; applied research, aimed at developing practices, techniques, and equipment to facilitate the use of marine resources; and advisory and information programs to provide scientists, engineers, educators, industrialists, and the general public with useful information on marine resources and discoveries through publications and the marine extension service. LSU's Office of Sea Grant

Development is responsible for effectively conducting the research, training, and information programs approved by NOAA for Sea Grant funding in Louisiana. Emphasis is given to the encouragement and development of programs involving scientific and economic aspects of marine environments, usually described as shallow-water, nearshore, coastal, or estuarine.

In 1978, LSU was named a Sea Grant College — the 13th university in the nation so designated and the highest classification attainable in the national program.

The Laboratory for Wetland Soils and Sediments studies sediment chemistry and plant relations in natural wetland ecosystems — salt marshes, fresh and brackish marshes and swamps, and floodplains. Nutrient cycling, the fate and effects of pesticides, toxic heavy metals, and petroleum hydrocarbons in wetlands are major areas of study. The Laboratory plays a significant role in research funded by the Louisiana Sea Grant College Program and also in contract research supported by several other federal and state agencies that deal with important soil and sediment problems in wetlands.

The faculty and staff of the Coastal Ecology Laboratory endeavor to understand coastal environments as ecological systems. The shallow continental shelf, the coastline, inshore estuaries, and wetlands form a boundary between upland ecological systems and the open ocean. This highly active region is neither oceanic nor upland, but a complex blend that incorporates functional aspects of both extremes and also unique properties of its own. Its organic production is as high as that of our most productive farmlands, and the attraction of this zone for fish, waterfowl, and furbearing mammals makes it a major fishery and hunting resource. At the same time, the coastal zone is heavily populated by man, and his activities permeate it and alter its normal functioning. Current research emphases include the functional analysis of whole ecological systems; the productivity and ecophysiology of wetlands; the primary productivity of offshore continental shelf waters; the structure and function of benthic systems; nutrient cycles in coastal ecosystems; fishery population dynamics and management; analysis of systems under stress; ecological impact analysis; and the interactions between ecology and economics.

The Ports and Waterways Institute, created in April 1981, will focus, promote, and administer the University's maritime-related research, education, and advisory activities. Emphasis will be given to the solution of practical problems confronting the maritime transportation and offshore supply industries of Louisiana and the United States. The University, in establishing the nation's first Ports and Waterways Institute, has an outstanding opportunity to achieve national and international recognition in a variety of scientific and technological fields associated with the study, management, and development of ports, waterways, and offshore support operations.

The following degrees are offered:

MARINE SCIENCES:

1. **M.S.:** In conjunction with requirements and scheduling specified in the current issue of the Bulletin of the Louisiana State University Graduate School the **Master of Science degree in Marine Sciences** requires:

a) A program of study approved by the Department Chairman and the student's major professor. The program will normally consist of a minimum of 24 hours of graduate-level courses and at least four 7000 or 8000-level courses. In addition, a proficiency in calculus is required. Electives may be chosen with the consent of the student's major professor from appropriate courses in the Department of Marine Sciences or other departments.

b) Research culminating in the preparation of an acceptable Master's thesis which should demonstrate the capacity for originality of thought, research, and facility in organizing material.

c) An average grade not lower than B and no lower than C in the courses offered for the degree.

d) Passing a final oral examination based largely on the student's area of specialization, aspects of his research program and past coursework.

e) Although a reading knowledge of a foreign language is not required of a candidate for the Master's degree, the major professor may recommend some exposure to a particular language if a large body of foreign-language literature exists in the candidate's specialty field. In some specialty fields, recommendations may be made to develop the student's proficiency in statistics, computer sciences, etc., rather than in a foreign language.

A 36-hour nonthesis degree option is also available, designed primarily for students who do not contemplate completing a doctoral program. In addition to the required core courses, students in this program must complete six hours of advanced course-work in one marine science specialty; six hours of courses in a minor field outside of marine sciences; and at least three hours in research.

2. **Ph.D.:** In conjunction with requirements and scheduling specified in the current issue of the Bulletin of the Louisiana State University Graduate School the **Doctor of Philosophy degree in Marine Sciences** requires:

a) A program of study approved by the student's major professor and advisory committee consisting of (1) at least 48 hours of coursework beyond the baccalaureate. (Coursework will include four core courses plus a minimum of 24 hours of appropriate 7000 or 8000-level courses. In addition, the student must select a minor in another department — or an internal minor approved by the Graduate Council. Electives may be selected from courses designed to complete the student's program of study.) (2) A maximum of 12 hours of research leading to a dissertation in some area of marine science.

b) An average grade not lower than B and no lower than C in the courses offered for the degree.

c) A reading knowledge of at least one language other than his native language. The language is normally to be selected from the following: German, Russian, French, Spanish, English. The candidate's selection should be based upon the abundance of foreign-language scientific literature in his field of specialization.

d) Passing a comprehensive qualifying examination covering the student's scientific background and training, coursework, and general capabilities in the scientific field. This examination should be taken during the first semester after the Master's degree is awarded.

e) Passing a comprehensive general examination in a manner that conclusively demonstrates the student's competence over broad segments of marine sciences and a high degree of familiarity with current progress in one or more minor fields.

f) Passing an oral final examination based on the dissertation research.

Concurrent degree programs are available with Public Administration (MPA) and Experimental Statistics. The concurrent MPA-MS program enables a student to obtain the Master of Public Administration and the Master of Science in Marine Sciences in five or six semesters, depending on his academic preparation. The purpose of the program is to prepare students for positions in the public sector dealing with coastal zone management, wetland resources, and marine life.

The MPAStat-MS program enables a student to obtain the Master of Science in Marine Sciences and the Master of Applied Statistics degree concurrently. The combined program provides a strong background for research and for statistical consulting in the marine field.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Chairman

Department of Marine Sciences

Louisiana State University

Baton Rouge, LA 70803

(504) 388-1558

SCHOOL OF FORESTRY AND WILDLIFE MANAGEMENT:

The School of Forestry and Wildlife Management has four laboratories on the LSU campus available for marine and marine-related research in the field of fisheries. The School also has access to various facilities of the Louisiana Wildlife and Fisheries Commission. Most notable is the marine lab at Grand Terre, Louisiana, and the Rockefeller Wildlife Refuge at Grand Chenier, Louisiana. At Grand Terre the facility has been used to study the effects of oil pollution on shrimp. At Rockefeller, cooperative research on mariculture is being conducted in some 60 ponds.

The School offers a **Master of Science** with a major in fisheries and a **Ph.D.** in Wildlife and Fishery Science. Requirements for the M.S. degree include 30 semester

hours of graduate work, including six semester hours of thesis research. There are no language requirements, and a minor is optional. The Ph.D. requires 48 semester hours of coursework plus at least 9 hours of dissertation research.

Curriculum offered: available in school catalog.

Faculty appointments: available in catalog.

To obtain further information, address inquiries to:

Assistant Director

School of Forestry and Wildlife Management

Louisiana State University

Baton Rouge, LA 70803

SCHOOL OF LAW: The Louisiana State University Law School gives particular emphasis to teaching and research in coastal and marine resources law. The proximity of the state to the northern Gulf of Mexico region, where considerable marine resource activity occurs, encourages interest and expertise in these matters. LSU law professors, associates and students are active in offshore oil and gas issues, mineral and fishery resource management problems, wetlands and shorelands boundary issues, recreation and environmental protection problems, etc. Law School personnel work closely with other departments of the University concerned with coastal and marine resources issues, especially the Center for Wetlands Resources and the Department of Marine Sciences. An **LL.M. (Master of Laws)** program with **specialization in Marine Resources Law and Policy** has been authorized in the Law School, but has not as yet been implemented.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Marine Law

Louisiana State University Law Center

Baton Rouge, LA 70803

MAINE MARITIME ACADEMY

Castine, Maine 04421

The Marine Maritime Academy is a four-year program which offers a **Bachelor of Science** degree with majors in Nautical Science and Marine Engineering. The curriculum also includes the classroom instruction, vocational training and seetime that prepares future deck and engineering officers for the U.S. Merchant Marine. The U.S. Coast Guard administers the unrestricted license examination (third mate, third assistant engineer) to all students at the end of their senior year. Special features of the program include two month training cruises for freshman and junior midshipmen aboard the 13,300 ton *Training Vessel State of Maine*. Second year students receive two months training aboard a merchant vessel giving them practical on-job training. The NROTC scholarship program is also available to qualified applicants interested in obtain-

ing a commission and beginning a career as a U.S. Naval or Marine Corps officers. Minor areas of study include Business Transportation, Humanities, Oceanography, Ocean Engineering, Marine Industrial Management, Naval Science and Nuclear Engineering.

The Academy graduates anywhere between 140 and 160 individual per year, all of whom receive excellent placement service into careers as deck or engineering officers on vessels such as tankers, dry cargo carriers, ore carriers and tugs. Many graduates also obtain positions ashore in marine-related businesses such as shipbuilding and other industrial and management endeavors.

Curriculum offered: available in school catalog.

To obtain further information, address inquiries to:

Director of Admissions

Maine Maritime Academy

Castine, ME 04421

MARINE ENVIRONMENTAL SCIENCES CONSORTIUM OF ALABAMA DAUPHIN ISLAND SEA LAB

Dauphin Island, Alabama 36528

The Marine Environmental Sciences Consortium is located at the Dauphin Island Sea Lab, adjacent to Mobile Inlet. The Consortium has a membership of 19 Alabama four-year colleges and universities including: Alabama State University, Montgomery; Auburn University, Auburn; Birmingham-Southern College, Birmingham; Huntingdon College, Montgomery; Jacksonville State University, Jacksonville; Livingston University, Livingston; Mobile College, Mobile; Samford University, Birmingham; Spring Hill College, Mobile; Talladega College, Talladega; Troy State University, Troy; Tuskegee Institute, Tuskegee; The University of Alabama, University; The University of Alabama in Birmingham, University Station; The University of Alabama in Huntsville, Huntsville; University of Montevallo, Montevallo; University of North Alabama, Florence; Auburn University, Montgomery; and the University of South Alabama, Mobile.

Total facilities available include the Dauphin Island Sea Lab, the Point Aux Pins Marsh Lab at Point Aux Pins, three marine research vessels and several skiffs.

The Dauphin Island Sea Lab consists of 27 buildings on the east end of Dauphin Island. Among these is a large instructional building containing well-equipped research labs, classrooms and library, a combination administration-recreation building, two 84-person dormitories, a two-story efficiency apartment building, a cafeteria, support buildings, an oceanographic equipment building, 13 three-bedroom houses and a diver training pool.

The University of Alabama owns the 250-acre marsh lab, the vessel maintenance facility and three diesel-powered research vessels including the 65-foot *R/V*

Rounsefell and several vessels in the 35- to 45-foot class. These facilities are made available as a part of the total MESC complex.

MESC is a public non-profit corporation chartered by the state legislature in 1971. It is not a degree-granting institution; one of its principal functions is to support its 19 degree-granting schools with necessary marine related course offerings to satisfy their degree programs. All 19 schools have at least a B.S. in Biology with emphasis in Marine Science. Those schools with graduate programs have marine science-related degrees through the Ph.D. in some cases.

Curriculum offered: available in catalog.

Faculty appointments: available in catalog.

To obtain further information, address inquiries to:
Director

Marine Environmental Sciences Consortium

Dauphin Island Sea Lab

Dauphin Island, AL 36528

THE MARINE SCIENCE CONSORTIUM, INC.

Wallops Island, Virginia 23337

PARTICIPATING INSTITUTIONS:

The American University, Washington, D.C. 20016

Bloomsburg State College, Bloomsburg PA 17815

California State College, California, PA 15419

The Catholic University of America, Washington,
D.C. 20017

Catonsville Community College, Catonsville,
MD 21228

Cheyney State College, Cheyney, PA 19319

East Stroudsburg State College, East Stroudsburg,
PA 18301

Edinboro State College, Edinboro, PA 16412

Indiana University of Pennsylvania, Indiana, PA 17551

Kutztown State College, Kutztown, PA 19530

Millersville State College, Millersville, PA 17551

The Pennsylvania State University, University Park,
PA 16802

Rochester Institute of Technology, Rochester,
NY 14623

Shippensburg State College, Shippensburg, PA 17527

Slippery Rock State College, Slippery Rock, PA 16057

West Chester State College, West Chester, PA 19380

West Virginia University, Morgantown, WV 26506

Each of the participating institutions offers courses in oceanography, for which classroom facilities, laboratory space, library and computer support are available on the various campuses.

The Consortium operates a field station at Wallops Island Marine Science Center, Wallops Island, Virginia, where more than 200 participants can be accommodated.

The physical facilities at the center consist of lecture rooms, wet and dry laboratories, dormitories, cafeterias, docking spaces and auxiliary buildings.

Vessels owned and operated by the Consortium include: The *R/V Delaware Bay*, a 50-foot, low-magnetic ex-mine diving tender equipped with radar, Loran, CBR and VHF radios, several winches, and diving lockers; the *Chincoteague Bay*, a 40-foot flat-bottom monitor for use in shallow waters; the *R/V Laughing Gull*, a 28-foot shallow draught aluminum boat for estuarine and bay work.

Degrees are granted only through the participating institutions and include **B.A. and B.S. in Biology, Geology, Geography, Earth Sciences** and **M.A., M.S., M.Ed., and Ph.D.** degrees.

Curriculum offered: available in catalog.

Faculty appointments: available in catalog.

To obtain further information, address inquiries to:
Director

The Marine Science Consortium, Inc.

P.O. Box 16

Wallops Island, VA 23337

(804) 824-5636

MARIST COLLEGE

Poughkeepsie, New York 12601

A program leading to a **B.S. in Environmental Science** with particular emphasis on aquatic studies is offered at Marist College. The curriculum is designed to prepare students to enter the job market as environmental technicians following graduation.

A breakdown of the science requirements follows:

1. Credit requirement in environmental science 23
2. Credit requirement in related fields (Biology, Chemistry, Computer Science, Mathematics, Economics, Internships) 51

Facilities include a laboratory directly on the Hudson River for the assembly and preparation of river samples as well as an array of chemistry (including analytical) and biology labs on the main campus, which is 250 yards from the river.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman, Division of Science

Marist College

Poughkeepsie, NY 12601

(914) 471-3240 x287

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Cambridge, Massachusetts 02139

Over the past two decades the Massachusetts Institute of Technology has developed a wide range of facilities for basic and applied research related to the

development of new oceanic knowledge and to the utilization of the oceans to meet societal needs.

In addition to the facilities in basic and engineering research in the various departments of the institute, the facilities of the Draper Laboratory as well as those of the Woods Hole Oceanographic Institution (WHOI) (Available to MIT through the joint MIT/WHOI Programs in both oceanographic engineering and in oceanography), the following special marine-oriented facilities are available at the MIT campus: variable pressure water tunnel, ship model towing tank, acoustics and vibration laboratory, ship design laboratory, *R/V Edgerton*, pressure testing facility, marine data systems laboratory, marine structural dynamics laboratory, a stroboscopic light laboratory and the water resources and hydrodynamics laboratory containing over 30,000 square feet devoted to teaching and research and including such facilities as a 100-foot wave channel, various channels for sediment studies, a coastal model basin, special flumes for variable density experiments, a special purpose digital computer for experimental control and data reduction, a special purpose analog computer for the analysis of random signals, plus instrumentation for the laboratory and field measurement of turbulence, wave profile and forces, entrained sediments, salinity, heat, dissolved oxygen, B.O.D., etc. Large scale digital computer facilities are available through the Engineering Departments and the MIT Information Processing Center.

The Department of Ocean Engineering concentrates on "engineering for the ocean environment." It emphasizes the scientific background and those engineering sciences necessary to applications in the marine field, as well as engineering fundamentals and their application to a wide spectrum of engineering for modern ocean sciences, ocean exploration, ocean transportation, ship and naval engineering, and the utilization of ocean and coastal zone resources. A flexible curriculum, a departmental faculty with wide and continuing research and industrial experience, and close faculty-student contact all contribute to a sound and effective education.

The following two undergraduate degrees are offered in the Department of Ocean Engineering:

1. **B.S. in Ocean Engineering.** All undergraduate students are required to take 72 units in the academic area of humanities and social science. In addition, 12 units of biology or chemistry subject matter, 24 units of physics and 24 units of calculus are required. Each student must fulfill the requirement of satisfactorily completing 12 units of credit in a laboratory course. All of the foregoing requirements involve subjects outside the Department of Ocean Engineering. The departmental requirements include the following mandatory subjects: Marine Applied Mechanics, A Survey of Ocean Engineering, Applied Ocean Engineering, Differential Equations, Dynamics, and Linear Systems and Probability.

Also 70 units of unrestricted electives plus at least 72 units of planned electives are required. At least one

planned elective subject must be selected in four out of these nine areas: acoustics, design, hydrodynamics, instrumentation, materials and fabrication, ocean environment, power and propulsion, probability and structures.

2. **B.S. in Naval Architecture and Marine Engineering.** Requirements are the same for the B.S. in Ocean Engineering except that out of the 72 units of planned electives at least one subject must be selected in each of the following areas: design, hydrodynamics, materials and fabrication, power and propulsion and structures.

The following graduate degrees are offered by the Department of Ocean Engineering:

3. **M.S. in Naval Architecture and Marine Engineering.**

4. **M.S. in Ocean Engineering.**

5. **M.S. in Shipping and Shipbuilding Management.**

6. **M.S. without specification.**

Preparation for these graduate degree programs usually includes an undergraduate degree in a field of engineering. Students with a background in physics, mathematics, or chemistry may also be accepted with the proviso that they complete background areas in which they are deficient. For students who lack the complete range of background requirements the department is prepared to consider the M.S. degree without specification.

7. **Ocean Engineer.** The objective of a program leading to an engineer degree is a more advanced level and a broader range of competence in engineering and science than that required for the master's degree, but with less emphasis on creative research than that characterizing a doctoral program. In general terms, the master's degree requires a minimum of one academic year and the engineer degree without a concurrent M.S. degree requires two academic years beyond a baccalaureate in the same field.

The requirements for an engineer degree are the satisfactory completion of a program of advanced study and research approved by the department. The minimum program consists of at least 162 subject units and the completion of an acceptable thesis. A department may accept a master's thesis of superior quality for the engineer degree.

A program for an engineer degree ordinarily includes two subjects in the area of economics, industrial management, or political science, and at least 12 units of comprehensive design, such as Design of a Waterborne Vehicle or the equivalent.

8. **Doctor of Science.**

9. **Doctor of Philosophy.**

The basic requirements for a doctorate degree are: completion of a program of advanced study, including a two-part general examination, and completion and oral defense of a thesis on original research.

The program of advanced study and research may be selected in any field approved by the department. The thesis is in this same field. The program often

comprises subject areas reaching into several departments. If the field requires substantial participation by two or more departments, an interdepartmental faculty committee may be appointed by the dean of the Graduate School to advise with a graduate registration officer in the administration of the student's program.

Candidates for a doctorate are no longer required to demonstrate a proficiency in foreign languages.

The Department of Ocean Engineering also offers a joint program in oceanographic engineering with the Woods Hole Oceanographic Institution leading to the degrees of Ocean Engineer, Ph.D., or Sc.D. awarded jointly by the two institutions. Students in this program choose to specialize in those areas of oceanographic engineering related to advancements in marine geophysics, geology, oceanography, or oceanographic instrumentation. Requirements for the joint degrees are similar to those of the corresponding degree awarded by the department above.

The Department of Civil Engineering also offers marine-related graduate degree programs in civil engineering. The focus of these programs is on coastal problems of the marine environment and on constructed marine facilities.

Preparation for these programs of graduate study usually includes an undergraduate degree in civil, mechanical or electrical engineering or oceanography; but, recognizing the possible need for some additional work, students with a background in physics, mathematics, chemistry, and biology may also be accepted. The degrees offered, and their requirements are as follows:

1. **M.S. in Civil Engineering.** This requires completion of an approved program of at least 66 subject units, of which 42 units must be in "A" subjects, and the completion of an acceptable thesis.

2. **M.S.** This "unspecified" degree is awarded in cases in which at least 34 units of "A" subjects plus the thesis are not from within the Department of Civil Engineering. This provides one mechanism for pursuing interdepartmental fields of interest.

3. **Civil Engineer.** The "professional" degree, Civil Engineer, is awarded for completion of a program at a more advanced level and over a broader range than that for the master's degree but with less emphasis on creative research than that characterizing a doctoral program. The program content is worked out by the student in consultation with his faculty advisor but must contain at least 162 subject units plus an acceptable thesis.

4. **Sc.D. or Ph.D. in Civil Engineering.** The basic requirements for the doctorate are: completion of a program of advanced study, including a general examination consisting of a written and an oral portion; and completion and oral defense of a thesis based on original research.

The total doctoral program must include at least 150 units of graduate subjects units up to half of which may be specified by the graduate committee in charge of

the candidate's major area of specialization. It is for this core material that the candidate is responsible on the general examination. Doctoral candidates are no longer required to demonstrate a proficiency in foreign languages.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

(Chairman, Appropriate Department)

Massachusetts Institute of Technology

Cambridge, MA 02139

The graduate program in oceanography is conducted jointly by MIT — those of Earth and Planetary Sciences, Meteorology and Biology — are involved in instruction in physical oceanography, marine geology, marine geophysics, marine chemistry and geochemistry, and biological oceanography. Each student has a primary affiliation with one of the three departments.

MIT provides instruction in many fields of science, engineering and the humanities, as well as laboratories, libraries, and computer and data processing services; additionally, a small research boat which is used for local observations and for instrument testing is docked at the MIT facility at Lewis Wharf in Boston. WHOI brings to the program a large scientific staff involved in many phases of oceanography, along with extensive laboratory facilities on shore and a fleet of sea-going ships devoted to research and instruction. Students may take courses simultaneously at both institutions, and transportation between the two campuses is provided. Thesis research may be undertaken at either institute, the locations of the thesis advisor and the needed facilities usually being the determining factors.

All MIT doctoral candidates in oceanography are considered to be in the joint program and are awarded a joint degree of **Ph.D. or Sc.D. in Oceanography**. (No distinction is made between the two and a student may choose whichever seems more appropriate to him.) In the first phase of the doctoral program, the student prepares himself for the general examination in the field of his degree; after successfully passing this, he enters the second phase, that of thesis research. The successful defense of a thesis of high quality marks the completion of the program.

The degree of **Master of Science** is awarded only by MIT. Minimum requirements are the completion of an approved program of 66 units, of which at least 42 must be graduate "A" subjects and the presentation of an acceptable thesis.

All applicants to the graduate program should have a strong background in basic mathematics and physics; chemistry is required for students of marine chemistry and biological oceanography while geology is needed for marine geology.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
 Joint Program in Oceanography
 Massachusetts Institute of Technology
 Room 54-912
 Cambridge, MA 02139

or,
 Woods Hole Oceanographic Institution
 Woods Hole, MA 02543
 (617) 548-1400

MASSACHUSETTS MARITIME ACADEMY

Buzzards Bay, Massachusetts 02532

The Massachusetts Maritime Academy offers an accredited, four year degree program to undergraduates preparing them for licensed service in the U.S. Merchant Marine. The Academy also offers a summer program of courses in the marine sciences to other interested students. The four year program includes three summers of practical training on board the Academy's 480-foot training ship *Bay State*. The summer program is supported by several power boats used to conduct field trips in the adjacent waters of the Cape Cod Canal, Buzzards Bay and Cape Cod Bay. The physical facilities of the Academy include a classroom building; administrative offices; laboratories in the physical sciences, engineering, and marine sciences; dormitories accommodating 800 students, a library of 50,000 volumes, gymnasium, dining hall and a computer center with seven terminals tied into a central computer servicing the Massachusetts State College System.

The following degrees are offered:

1. B.S. in Marine Transportation leading to a Third Mate License.

- | | |
|--|------------|
| a) Humanities | 9 credits |
| b) Social Sciences | 14 credits |
| c) Basic Sciences | 26 credits |
| d) Naval Science (Qualification for Naval Research Commission) | 6 credits |
| e) Marine Engineering Science | 2 credits |
| f) Nautical Science (Major) | 63 credits |
| g) Elective | 11 credits |
| h) Sea Terms (three two-month cruises) | 24 credits |

2. B.S. in Marine Engineering leading to Third Assistant Engineer's License.

- | | |
|--|------------|
| a) Humanities | 9 credits |
| b) Social Sciences | 10 credits |
| c) Basic Sciences | 31 credits |
| d) Naval Science (Qualification for Naval Research Commission) | 6 credits |
| e) Nautical Science | 6 credits |
| f) Marine Engineering Science (Major) | 61 credits |
| g) Electives | 11 credits |
| h) Sea Term (three two-month cruises) | 24 credits |

Curriculum offered: available in school catalog.
 Faculty appointments: available in school catalog.
 To obtain further information, address inquiries to:
 Academic Dean
 Massachusetts Marine Academy
 Buzzards Bay, MA 02532

McGILL UNIVERSITY

Montreal, Quebec, Canada

Research at the Institute of Oceanography of McGill University is carried out in a broad diversity of marine environments, including the Arctic regions, the Gulf of St. Lawrence, the estuary of the St. Lawrence River, and the Caribbean Sea. Biological collections are available at the Redpath Museum of McGill University, with special laboratory facilities for the study of marine invertebrates. An up-to-date collection of publications in oceanography and related matters, as well as many journals in the marine fields, is kept in the library of the Institute.

The Bellairs Research Institute of McGill University in Barbados, West Indies, which opened in 1954, is a research center specializing in tropical marine ecology.

Masters and doctoral degrees are offered in the following subjects: marine biology, physical oceanography and marine geology. Graduate students are expected to take certain basic courses, including those considered necessary for their training and for the development of their particular fields of specialization. Primary emphasis for both the M.Sc. and Ph.D. degrees is placed upon research and thesis presentation. Ph.D. candidates are required to pass a comprehensive examination within two years of registering in the program; this examination covers the whole field of marine science, but allows for the specialized interests and training of each student. Ph.D. candidates are also required to defend their thesis at an oral examination.

Curriculum offered: available in school catalog.
 Faculty appointments: available in school catalog.
 To obtain further information, address inquiries to:
 Chairman
 Institute of Oceanography
 McGill University
 3620 University Street
 Montreal, Quebec
 Canada H3A 2B2

MIAMI DADE COMMUNITY COLLEGE

Miami, Florida 33136

Miami Dade Community College has a marine technician training facility located on the Miami River approximately 3.5 miles from the Downtown Campus. In conjunction with the Marine Science Technology Department, students are eligible to take courses at North

and South Campus respectively. All marine science courses must be taken at the Marine Science Facility.

The department owns and operates a 46-foot research vessel, the *R/V Martech*, two 20-foot outboards — *R/V Explorer* and *R/V Observer*. These vessels are used extensively for survey and field work in Biscayne Bay, the coral reefs located in the Florida Keys, as well as in the Gulf Stream off Miami. The *R/V Martech* is equipped with FM-VHF radiotelephone, MF-AM radiotelephone, Decca radar, Loran, Raytheon fathometer, Ross bottom profiler, 7.5 kw Onan generator, hydraulic winch and A-frame. It carries 400 gallons of diesel fuel and 200 gallons of fresh water. Cruising speed is 14 knots. This vessel is capable of light duty trawling, light hydraulic tool operation and as a hard-hat diving support vessel. The smaller 20-foot vessels act as support vessels.

The research equipment within the department consists of an STD (Salinity, Temperature and Depth) recording system, XBT (Expendable Bathythermograph), analog recorder with computer interface capabilities, proton magnetometer, submarine photometer, bongo nets, otter trawls, seine nets, microscopes, scuba equipment, KMB-9 band mask, Helle communications equipment, Aquadyne Air-Hat, Swindell Air-Hat, Nikonos II camera equipment, underwater 16mm movie cameras, Sony video-recorder with underwater housing, hydraulic pneumatic tools, underwater welding-cutting capabilities, metal fabrication shop (machine welding), boat engine repair shop, fiberglass-plastics fabrication, spectrophotometer, centrifuge induction salinometer and electronic instrumentation repair laboratory.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Department Chairman

Marine Science Technology Program

Miami Dade Community College

North Campus

Miami, Florida 33136

MICHIGAN STATE UNIVERSITY

East Lansing, Michigan 48823

Michigan State University has research and teaching facilities for work in limnology and oceanography on the main campus in East Lansing and at the W.K. Kellogg Biological Station at Hickory Corners, Michigan. In addition, use is made of the nearby Great Lakes and of affiliations with several marine stations.

Facilities on the main campus are available through the Departments of Fisheries and Wildlife and Geology. The facilities include numerous laboratories with standard analytical equipment; a special laboratory with 19 ponds for controlled experiments on the banks of the Red Cedar River on the main campus; a nuclear reactor; an automated, multichannel gamma counter for neutron activation analysis and isotope analyses; a scanning electron microscope; an electron micro-

probe; an x-ray diffraction meter; x-ray fluorescence equipment; an infrared spectrometer; a Coulter counter; chromatographs, a seismic play-back center; bomb calorimeter; and a carbon analyzer. Field equipment includes a 20-foot launch and many smaller boats; biological-, sediment- and water-sampling devices; magnetometers; gravity meters; a seismic van and requisite support equipment. The W.K. Kellogg Biological Station is a separate entity affiliated through teaching and research programs with the College of Natural Science. Courses are offered during the summer session and research conducted throughout the year. Laboratory and boat facilities are duplicated at the station.

The following degrees are offered:

1. **B.S. in Fisheries and Wildlife**, specializing in Fishery Biology and Limnology. Requirements: 43 credits in the social sciences and humanities; completion of credits in biological sciences, chemistry, geology, mathematics, physics and soil science; 40 to 43 credits in professional core curriculum for specialty, and 23 to 49 other elective credits.

2. **M.S. in Fisheries and Wildlife**, specializing in Fish Management, Fishery Biology, Limnology or Pollution Biology. Requirements: completion of 45 credits past the bachelor's degree of which 8 to 22 hours must be in research and completion and defense of a master's thesis.

3. **Ph.D. in Fisheries and Wildlife**, with specialties listed above. Requirements: completion of a minimum of 36 credits above the equivalent of a master's degree; 12 credits in thesis research and successful completion of a dissertation; competence in one or two of the following areas for which nine credit hours may be taken: education, communications, foreign language, computer science, systems science, philosophy, mathematics or any other discipline acceptable to the student's committee, and oral or written examinations for degree candidacy and for defense of the dissertation.

4. **B.S. in Geology**, with specialization in Marine Geology, Geophysics or Geochemistry. Requirements: 60 non-science credits; mathematics through Calculus III or Calculus II plus a course in statistics; chemistry equivalent to three quarters of study; 12 credits in physics; geology courses and a total of at least 180 hours. Courses in marine and aquatic sciences offered in fisheries and wildlife are considered as non-science electives and are strongly encouraged.

5. **M.S. in Geology**, with specialization in Marine Geology, Geophysics or Geochemistry. Requirements: minimum of 45 credits of which up to 10 can be for thesis research and completion and defense of a master's thesis.

6. **M.A.T. in Geology** with specialization as above. Requirements: candidates must have a teaching certificate prior to receipt of the degree, a minimum of 45 credits, in addition to those required for the teaching certificate, and successful completion of a comprehensive examination, oral or written.

7. **Ph.D. in Geology** with specialization as above. Requirements: completion of a suitable curriculum as determined by the candidate and his guidance committee, completion of a foreign language requirement or a suitable substitute as approved by the guidance committee, oral and/or written examinations for degree candidacy, which must be passed prior to initiation of dissertation research, and for defense of the dissertation, and successful submission of a dissertation.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman
Department of Geology
Michigan State University
East Lansing, MI 48823

MISSISSIPPI STATE UNIVERSITY

Mississippi State, Mississippi 39762

Mississippi State University has marine-related research and teaching facilities on the main campus near Starkville and on site at the National Space Technology Laboratory (NSTL) of NASA at Bay St. Louis, Mississippi. Facilities on campus include classrooms, computers, an electron microscopy lab, chemical and biological analysis laboratories, and related support services. At NSTL, MSU operates field experiments, chemical and biological laboratories, land and water transportation services, and conference facilities. MSU also utilizes Mississippi's Gulf Coast Research Laboratory in marine-related education, research, and advisory services programs (see GCRL for facilities).

The following degrees or marine science related options are offered:

1. College of Engineering, Department of Mechanical Engineering: **Bachelor of Mechanical Engineering** with Marine Engineering option.

2. Mississippi State University offers a degree in Marine Engineering at its main campus location. The Marine Engineering curriculum leads to the degree of **Bachelor of Science in Mechanical Engineering** (Marine Engineering option). The program is designed to prepare students to enter the marine construction industry. Primary emphasis is placed on the many engineering and management aspects of ship construction. Laboratory facilities are shared with other departments in the College of Engineering which have a total laboratory space of 170,000 square feet.

A 134 semester-hour curriculum constitutes the requirements for the degree. The first two years of the curriculum may be taken at a junior college or community college. Coursework taken during these two years should consist of usual pre-engineering graphics, physics, descriptive geometry, etc.

3. College of Arts and Sciences: **Master of Science** with marine specialties in Botany, Geology, Microbiology or Zoology. Requirements: 30 semester hours, one foreign language and thesis. **Ph.D.** with marine specialties in Botany, Microbiology, or Zoology. Requirements: varied coursework, minimum of one foreign language and dissertation.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Marine Engineering Program
Mississippi State University
Drawer ME
Mississippi State, MS 39762

MONTANA STATE UNIVERSITY

Bozeman, Montana 59717

A **Bachelor's degree in Fish and Wildlife Management** is offered to undergraduate students with special interest in these fields. The curriculum is concentrated on fundamental biology with considerable work in related sciences, resulting in a firm grounding in biological sciences with an ecologic emphasis.

Students graduating with a bachelor's degree will be qualified for such positions as conservation officers, refuge managers, park naturalists, and assistant fishery and wildlife technicians. The curriculum is not designed to give sufficient preparation for undertaking independent fish and wildlife investigations or management but is intended to give prospective fish and wildlife biologists adequate background for graduate study.

Those desiring opportunities as fish or wildlife biologists should undertake graduate study which includes management courses, field experience and work on practical problems. The Department will not recommend students for positions requiring independent investigation without graduate study and experience.

M.A. programs in Fish and Wildlife Management and **M.S. and Ph.D. programs in Biological Sciences** are available to students in fishery science and aquatic biology. Research within the Fish and Wildlife Management M.S. program is generally directed toward applied aspects with state and federal natural resource agencies commonly sponsoring and cooperating in projects. The locale offers exceptional opportunities for study of stream and lake fisheries and limnology in a variety of settings varying from lowland to alpine. The U.S. Fish and Wildlife Service Cooperative Fishery Research Unit for Montana is housed in the Department, and the USFWS Bozeman Fish Cultural Development Center is located nearby.

The six aquatic faculty members represent expertise in the biology, ecology and management of fishes, limnology, stream ecology, aquatic invertebrates, and quantitative ecology, and adjunct staff teaches aquaculture. This aquatic concentration is broadly sup-

ported by other faculty in related fields such as botany, zoology, genetics, wildlife science, chemistry and microbiology.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Head, Department of Biology

Lewis Hall

Montana State University

Bozeman, MT 59717

(406) 994-4548

NAVAL POSTGRADUATE SCHOOL

Monterey, California 93940

Air-Ocean Sciences Programs at the Naval Postgraduate School (NAVPGSCOL), Monterey, California, are designed to provide graduates with a thorough understanding of either air-ocean, atmospheric, oceanographic, or hydrographic sciences and to develop the technical expertise necessary to apply the knowledge of these sciences in support of all aspects of military operations. Currently Air-Ocean Curricula are open to U.S. officers of all uniformed services, allied officers and civilian employees of the U.S. federal government. Curricula include: Air-Ocean Science, Air-Ocean Tactical Environmental Support, Hydrographic Sciences, Oceanography and Meteorology.

Qualifications for admission common to all curricula include a baccalaureate degree or the equivalent with above average grades in mathematics and the physical sciences. For admission to the Air-Ocean Science Curriculum, the undergraduate degree should be in meteorology, oceanography or the equivalent if possible. Completion of mathematics through differential and integral calculus and one year of college physics is considered minimal preparation. A year of college chemistry is also required for all curricula with the exception of meteorology.

AIR-OCEAN SCIENCE: While this curriculum is open to officers of the other U.S. military services, allied officers and qualified civilian employees of the U.S. Federal Government, its availability to U.S. Naval officers is limited to those of the Restricted Line (Special Duty Geophysics). Successful program completion leads to the award of the degree of **Master of Science in Meteorology and Oceanography**. Naval officers are also awarded the XX47P subspecialty billet code upon successful program completion.

This program's objective is to provide qualified personnel a thorough understanding of the air-sea environment and to develop the technical expertise to provide and utilize meteorological and oceanographic data and knowledge in support of all aspects of military operations. This education enhances performance in all duties throughout a career including operational bil-

lets, technical management assignments and policy-making positions. Students develop sound graduate level technical ability based on general engineering and scientific principles, build a new appreciation for continuing education, acquire diverse professional knowledge, develop analytical ability for practical problem solving, broaden their capacity for original thought and discover a new professional confidence that leads to productive achievement throughout their careers.

The Air-Ocean Science Curriculum is interdisciplinary in nature and encompasses those areas of meteorology, oceanography, and hydrographic sciences which are directly related to environmental support of military operations. Classroom instruction is supplemented by laboratory exercises both ashore and afloat. The Research Vessel *Acania* is sponsored by the Oceanographer of the Navy for class laboratory experience as well as for individual research efforts. Guest lectures, seminars, sponsored research chairs, visiting eminent scientists, and field trips serve to round out the curriculum. Close proximity of the Fleet Numerical Oceanography Center and the Naval Environmental Prediction Research Facility are most conducive to effective liaison on operationally significant problems and germane research. A master's thesis is required. Upon completion of this program, a student is qualified to independently serve as a meteorological and oceanographical forecaster in support of military operations.

Matriculation may occur any quarter with preferred entry in the fall and spring. A typical program for a well-qualified student is eight quarters (two years).

HYDROGRAPHIC SCIENCES: This curriculum is open to all Naval officer unrestricted line communities (surface, sub-surface and aviation), officers of other U.S. services, allied officers and qualified civilian employees of the U.S. Federal Government. Successful program completion leads to the award of the degree of **Master of Science in Meteorology and Oceanography**. Naval officers are also awarded the XX49P subspecialty billet code upon successful program completion.

The program's principal objective is to provide students with a thorough understanding of the air-sea environment and operations analysis principles to forecast atmospheric, oceanic and acoustic conditions which affect operations, tactics and strategy in all areas of Naval warfare (air, surface, and sub-surface). Primary emphasis is placed on the understanding of the impact of the environment (atmosphere, ocean and their interface) on weapons systems, sensors, platforms, and communication systems (including electromagnetic, optical and acoustic propagation). The program recognizes the importance of interactions between the atmosphere and the oceans, and deals with the relationship at the air-sea interface. A master's thesis is required.

Interdisciplinary in content, this curriculum provides a firm foundation in meteorology and oceanography. Though similar in content to the Air-Ocean Science curriculum, this curriculum provides a sequence of

courses in operations research and physics germane to stated program objectives.

Matriculation may occur any quarter; preferred entry is in the fall or spring. The program is eight quarters (two years) in length.

HYDROGRAPHIC SCIENCES: This program is open to officers of the National Oceanic and Atmospheric Administration, Coast Guard, Corps of Engineers, allied officers and qualified civilian employees of the U.S. Federal Government. Successful program completion leads to the award of the degree **Master of Science in Hydrographic Sciences**.

This program's objective is to provide students with a sound understanding of oceanography, geodetic science, and hydrography. Hydrography (a subdiscipline of mapping, charting and geodesy (MC&G)) is the science of the measurement, description and charting of the sea floor with special reference to navigation and marine operations. This interdisciplinary program integrates the scientific principles of oceanography with the practical engineering procedures of hydrography. Students achieve the technical expertise to provide and utilize hydrographic data in support of all aspects of hydrographic operations. This education enhances performance in duties associated with operational billets, technical management assignments and policy-making positions.

This curriculum recognizes the importance of precise positioning systems, error budget analysis, accuracy requirements, data collection methods and data reduction techniques as applied to the planning, conduct and evaluation of hydrographic, magnetic and gravity surveys. Graduates are prepared to make optimum use of the ocean environment in the course of their duties and to conduct and evaluate research in oceanography and hydrography, both basic and applied. Classroom instruction is supplemented by laboratory exercises both ashore and afloat. The *Research Vessel Acania* and a hydrographic launch are available for class laboratory experience as well as for individual research efforts. Additionally, the National Oceanic and Atmospheric Administration provides laboratory time aboard working hydrographic survey ships. Each student is required to complete a master's thesis, the subject of which often addresses a problem of scientific interest and practical value to the student's sponsoring agency.

Typical program length is eight quarters (two years). Preferred matriculation is in the fall.

OCEANOGRAPHY: This program is open to officers of other U.S. military services, allied officers and qualified civilian employees of the U.S. Federal Government. Successful program completion leads to the award of the degree **Master of Science in Oceanography**.

The Oceanography curriculum's objective is to provide students with sound understanding of the science of physical oceanography and to develop the technical expertise to provide and utilize oceanographic and acoustical data in support of all aspects of military operations. Particular emphasis is placed on the understanding of oceanic effects on the solution of the undersea warfare problem. This education enhances performance in all duties throughout a military career

including operational billets, technical management assignments and policy-making positions. A master's thesis is required.

The focus in this program is on modern Physical Oceanography. Topic areas which are addressed include: dynamical oceanography and meteorology; physical oceanography and marine meteorology; satellite oceanography and meteorology; acoustic and non-acoustic anti-submarine warfare principles; shallow water and nearshore oceanography of extended jurisdiction zones; all scales of oceanic variability; methods of ocean prediction; regional and synoptic oceanography and meteorology — including polar, tropical, and other areas; air-sea interaction; oceanic data systems; methods of optimum — track ship routing, search and rescue modeling, spectral wave modeling, tidal level and current modeling, and storm surge modeling; influence of physical oceanic phenomena on marine resources and their management; and, interaction of ships with waves.

Matriculation may occur any quarter; preferred entry is in the fall. The program is typically eight quarters (two years) in length but may be adjusted depending on individual student's qualification. A *Ph.D. program is also available*.

METEOROLOGY: This program is open to officers of other U.S. military services, allied officers and qualified civilian employees of the U.S. Federal Government. Successful program completion leads to the award of the degree **Master of Science in Meteorology**.

Atmospheric conditions that prevail throughout the world are frequently important, even critical, to the planning and execution of military and civil operations. The objective of the Meteorology curriculum is to provide students with a sound understanding of the science of meteorology and to develop the necessary expertise to provide and utilize meteorological data in support of all aspects of weather-dependent operations. Interdisciplinary in content, this program encompasses those areas of meteorology which are directly related to the environmental support of operations. Course sequences in synoptic and dynamic meteorology as well as numerical prediction are included. The importance of the air-sea interface is also recognized and addressed directly. Classroom instruction is supplemented by laboratory exercises, computer solutions to various problems and guest lectures and seminars. A master's thesis is required. Upon completion of the program, the student is qualified to serve independently as a meteorological forecaster.

Matriculation may occur any quarter with preferred entry in the fall. Typical program length is six to seven quarters (1½ to 1¾ years). A *Ph.D. program is also available*.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Air-Ocean Sciences Curricular Officer
Code 35
Naval Postgraduate School
Monterey, CA 93940
(408) 646-2044/AUTOVON 878-2044

NEW JERSEY MARINE SCIENCES CONSORTIUM

Ft. Hancock, Sandy Hook, New Jersey 07732

The New Jersey Marine Sciences Consortium operates two field stations for teaching and research. The northern field station is located at Sandy Hook within the Gateway National Recreation area; the southern field station is in Seaville, Cape May County. Both field stations provide teaching and research laboratories, classrooms, and libraries. Housing and food services are available all year at Seaville and during the summer months at Sandy Hook. Vessels range from 15 feet to 34 feet. Both field stations provide laboratory, field equipment, and sampling gear for use on the vessels.

The NJMSC is a non-profit corporation comprised of 23 member institutions:

Atlantic Community College, Mays Landing, NJ
Bergen Community College, Paramus, NJ
Brookdale Community College, Lincroft, NJ
Cumberland County College, Vineland, NJ
Essex County College, Newark, NJ
Fairleigh Dickinson University, Rutherford, NJ
Glassboro State College, Glassboro, NJ
Jersey City State College, Jersey City, NJ
Kean College of New Jersey, Union, NJ
Lehigh University, Bethlehem, PA
Monmouth College, W. Long Branch, NJ
Montclair State College, Upper Montclair, NJ
New Jersey Institute of Technology, Newark, NJ
Princeton University, Princeton, NJ
Ramapo College, Mahwah, NJ
Rider College, Lawrenceville, NJ
Rutgers University, New Brunswick, NJ
Seton Hall University, South Orange, NJ
Stevens Institute of Technology, Hoboken, NJ
Stockton State College, Pomona, NJ
Trenton State College, Trenton, NJ
Union College, Cranford, NJ
William Paterson College, Wayne, NJ

Graduate and undergraduate courses for credit are taught at the NJMSC field stations. Students must register through a member institution to gain credit.

While the NJMSC is not a degree-granting institution, credits for the courses offered are applied to undergraduate or graduate degree programs at the member institutions or transferred to another institution. Students from out of state and from non-member institutions may take courses provided they register through a member institution.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director, Education Programs

New Jersey Marine Sciences Consortium

Ft. Hancock

Sandy Hook, NJ 07732

NEW YORK OCEAN SCIENCE LABORATORY

Montauk, New York 11954

The New York Ocean Science Laboratory (NYOSL), a center for integrated programs of research and development in the marine sciences, was founded by its present director, Dr. John C. Baiardi. The Laboratory is operated under the auspices of a consortium of eight metropolitan colleges and universities known as Affiliated Colleges and Universities, Inc.

The member institutions of the consortium include: Adelphi University, Fordham University, Hofstra University, Long Island University, New York University, St. John's University, New York Institute of Technology and State University of New York. The Laboratory supplements and augments the programs provided by the consortium. Courses are offered at the Laboratory in conjunction with them. However, NYOSL does not itself grant degrees.

It does provide opportunity for sponsored thesis research which is applicable towards an **M.S.** and **Ph.D.** degree granted by the member institution. It also offers:

1. Internship Program in effect with several colleges where qualified students are admitted to a one-semester work experience at NYOSL. The student receives up to 16 hours of credit from the home institution.

2. A Minimester Program where research experience is provided during the three-four week period in the Winter recess.

3. Trainee-volunteer program for qualified graduate and undergraduate students for research experience during the Fall, Spring or Summer periods.

The Laboratory supports multi-disciplined research and education in various facets of marine science. It has laboratories and research programs in microbiology, phytoplanktonology, zooplanktonology, ichthyology, macroalgae, chemical oceanography, natural products chemistry, physical oceanography, meteorology, vertebrate and invertebrate marine biology and mariculture of lobsters, clams, mussels and finfish, such as striped bass, flounder and eels.

The New York Ocean Science Laboratory also has the necessary basic laboratory equipment and supplies to support its programs. Among the special equipment are: electron microscopes, both penetrating (RCA) and scanning (JEOL-S25), with the necessary specimen-preparation and film-processing facilities; gas chromatography equipment for hydrocarbon analysis; controlled temperature environmental chambers of various sizes; two atomic absorption machines; ultraviolet, infrared and DU spectrophotometers; gamma and beta scintillators; Technicon (four channel) and a high pressure liquid chromatography unit. The data generated is stored by means of a telephone tie-line to the Brookhaven National Laboratory's computer bank.

There are several running seawater laboratories containing both indoor and outdoor tanks. These can be managed in flowthrough or recycled modes and the water can be filtered and temperature controlled. These facilities are associated with the mariculture programs as are the greenhouses for the growth of algae and baby bivalves.

A weather station measures wind speed, barometric pressure, temperature-humidity and solar radiation. The NYOSL library has more than 8,000 volumes and includes the Long Island Collection which was funded through a grant from the Hayden Foundation. This collection provides a complete library of all the research known to the Laboratory involving the waters around Long Island.

Located on 36 acres at Fort Pond Bay, Montauk, New York, the site and accommodations of the various buildings, with more than 300,000 square feet of available floor space, make them well suited for an oceanology complex. An 850-foot L-shaped pier and helicopter pad are available. More than 80,000 square feet of available space have been converted into ocean science and research laboratories.

Among the vessels used by the Laboratory are: a 42-foot refitted sports fisherman, three Boston Whalers and a catamaran fitted for inshore seining.

Curriculum offered: available in catalog.

Faculty appointments: available in catalog.

To obtain further information, address inquiries to: President-Director

New York Ocean Science Laboratory

Edgemere Road

Montauk, NY 11954

(514) 668-5800

NICHOLLS STATE UNIVERSITY

Thibodaux, Louisiana 70301

Nicholls State University has a marine science laboratory at Port Fourchon (near Grand Isle), Louisiana. This facility is used for marine and estuarine research projects and for field trips by the University's students and faculty. The physical facility includes a portable walk-in cold room, a shop, instrument and storage rooms, a dry laboratory and a large area which is utilized as a wet laboratory. The facility has complete dining and sleeping facilities for sixteen persons. A Boston Whaler equipped with two 70 horsepower outboard motors, along with several aluminum skiffs are available. In addition to these vessels, the University leases a 65-foot shrimp trawler for use in conducting marine research on the Louisiana continental shelf. Specialized equipment located either at the laboratory or at the University's main campus includes salinometer, pH meters, spectrophotometers, gas-liquid chromatography, thin-layer chromatography, electro-

phoresis, oxygen analyzers, BOD and COD analyzers, sediment analysis equipment, incubators, centrifuges, microscopes and photographic equipment.

The University awards the **Bachelor of Science** degree, with a major in Marine Biology, to a student who, in addition to satisfying the minimum requirements for graduation from the College of Life Sciences and Technology, meets the following requirements:

1. Completion of the curriculum outlined for Marine Biology majors with a grade of "C" or better in all science courses.

2. Completion of 49 hours of biological science courses and 12 hours of Biological Science electives. A Biological Science elective includes those courses titled: Biology, Botany, Microbiology, and Zoology.

3. Students wishing to minor in Chemistry must take core courses outlined in the school catalog, and at least three additional hours in other Chemistry courses approved by the Head of the Chemistry Department. A student wishing to minor in some other academic field must consult with his advisor.

Undergraduate marine, geology and geography courses also are offered to prepare students for graduate work in the marine environment or simply to add depth to their general background.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to: Director

Nicholls State University Marine Laboratory

Department of Biological Sciences

P.O. Box 2021

Thibodaux, LA 70301

NORTH CAROLINA STATE UNIVERSITY

Raleigh, North Carolina 27650

The graduate program in Marine Science is offered by the Department of Marine, Earth and Atmospheric Sciences. The laboratories and teaching facilities of the Department are located on the Raleigh campus. Access to coastal facilities are available through cooperative arrangements with others organizations. Such arrangements have been made with Duke University and the National Marine Fisheries Laboratory at Beaufort, the North Carolina Marine Resources Center at Manteo, Bogue Banks and Ft. Fisher at UNC's Marine Institute at Morehead City, North Carolina.

The Department is a member of a consortium which operates the UNOLS vessel *R/V Cape Hatteras*. Other research cruises take place in Duke's *John De Wolf* or Cape Fear Technical Institute's vessel *Advance II*. Research cruises have also been done cooperatively with institutions outside the State, such as the University of Georgia and the University of Rhode Island.

The **M.S.** and **Ph.D.** degrees are offered in the areas of Biological, Chemical, Geological and Physical Oceanography. The M.S. degree normally requires a minimum of 30 credit hours with concentration in one of the above areas. It is possible to obtain the M.S. degree with or without a thesis. The Ph.D. requirements are normally determined by the student's advisory committee and is intended to provide some breadth in the student's program. Each student is expected to participate in the graduate seminar course and in field work or an oceanographic cruise.

The student will normally take most of his coursework from those offered by the Department. However, courses that are of interest to our students are also offered by the Departments of Civil Engineering, Mechanical and Aerospace Engineering, Zoology, Mathematics and Statistics.

During the past year one Ph.D. and five M.S. degrees were granted by the Department.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to: Graduate Administrator

Department of Marine, Earth and Atmospheric Sciences

North Carolina State University

P.O. Box 5068

Raleigh, NC 27650

(919) 737-3711

NORTHEASTERN ILLINOIS UNIVERSITY

Chicago, Illinois 60625

Northeastern Illinois University offers an interdisciplinary program in limnology and the marine sciences. The principal teaching and research center is located on the university campus approximately four miles from Lake Michigan. Because of the proximity, size and regional importance of the lake, a number of year-round projects are being pursued in this area. Facilities at the University include several research vessels up to 400 gross tons, water and sediment sampling gear, underwater photography equipment, a complete sediment analysis lab (including X-ray fluorescence and X-ray diffraction), three large laboratory-lecture rooms, a photography lab, a weather facsimile recorder and a seismology lab. Coastal oceanography courses and research projects are run during the summer at field camps on the Atlantic and Gulf coasts and on Lake Michigan at the main campus.

The undergraduate students interested in oceanography may follow a program leading to a **Bachelor's degree in the Earth Sciences, Geography and Environmental Studies**, or the Kaskaskia Plan, with a concentration in oceanography. The Kaskaskia Plan for Individualized Curricula, allows the undergraduate to plan his/her total academic career using the facilities available at Northeastern and thus would be particularly

useful to the student interested in oceanography. Graduate students may obtain a **Master's degree in Geography and Environmental Studies or Earth Sciences** with a concentration in oceanography.

The following degrees are offered:

1. **B.S. in Earth Sciences.** Three semester hours in each of the following areas: Geology, Meteorology, Oceanography and one field course; 18 semester hours in Earth Science electives; and 15 hours in other natural sciences and Mathematics.

2. **M.S. in Earth Sciences.** Thirty semester hours in graduate Earth Science courses and a total of at least 45 semester hours of combined graduate and undergraduate level Earth Science credit. A thesis is required.

3. **B.A. in Geography and Environmental Studies.** Nine semester hours in each of the following areas: Physical Geography, Human Geography and six hours in Regional Geography and three of the nine hours of Physical Geography may be taken in Marine Science courses.

4. **M.A. in Geography and Environmental Studies.** The requirements include 33 hours in Geography and Environmental Studies (six hours of which may be taken for thesis credit). Three courses (three credits each) are required: Cartography, Statistics for Earth Sciences and Geography, and Scope of Philosophy of the Geographical Sciences. The remaining 18 hours may be taken in Marine Science courses, and the program must be organized systematically under the guidance of the faculty advisor.

5. **Kaskaskia B.A. Experimental Plan/Marine Sciences.** The requirements stipulate that the student plan his/her total four year curriculum in conjunction with a University advisor and an outside advisor. This would allow a strong concentration in the physical sciences.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman, Department of Earth Sciences

Northeastern Illinois University

5500 N. St. Louis Avenue

Chicago, IL 60625

(313) 583-4050

NORTHEASTERN UNIVERSITY

Boston, Massachusetts 02115

Northeastern University's Marine Science and Maritime Studies Center, established in 1982 in the College of Arts and Sciences, encompasses the College's several marine educational program. The Center (formerly the Marine Science Institute) is based at the Marine Science Laboratory, occupying a 16-acre site on the shore at Nahant, Massachusetts. Faculty, graduate students and advanced undergraduates utilize the facility for research in marine biology, ecology, experimental biology, and coastal geology. During summers, special courses are offered wholly at Nahant; during

the regular academic year, laboratories of marine-related courses are held there.

Although the Center has no graduate program of its own, graduate students in Biology and occasionally in other departments may specialize with both course work and research in marine topics. About 3 or 4 Ph.D.'s and 8-10 M.S.'s annually are awarded in this area.

Undergraduates majoring in the various sciences (as well as those majoring in other disciplines) may pursue a formal minor in Marine Studies. *SeaQuarter*, a program of academic study aboard a sailing vessel, was initiated in 1982.

Northeastern University's cooperative education (work/study) program gives many undergraduates job experience with placements at marine laboratories and marine-related businesses.

The College is in the process of further developing its marine programs, including potential student and faculty-exchange with the University of Oregon.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:

Director

Marine Science & Maritime Studies Center
Northeastern University
East Point, Nahant, MA 01908
(617) 581-7370

or,

Director of Admissions
Northeastern University
360 Huntington Avenue
Boston, MA 02115
(617) 437-2200

NOVA UNIVERSITY

Dania, Florida 33004

The Oceanographic Center of Nova University is concerned with studies and investigation in experimental and theoretical oceanography. Studies include modeling of large-scale ocean circulation, coastal dynamics, ocean-atmosphere coupling, coral growth and coral reef assessment, physiology of marine phytoplankton, calcification of invertebrates, cell ultrastructure, feeding effects, marine fisheries, lobster migration and larval recruitment. Primary regions of interest include Florida's coastal waters, the continental shelf and slope waters of the southeastern U.S., the waters of the Caribbean and Gulf of Mexico, and the equatorial Atlantic and Pacific Oceans.

The Institute of Coastal Studies is an academic and research unit of Nova University located at the Oceanographic Center. Multidisciplinary studies focus on contemporary problems and conflicts arising from increased use of coastal areas. Emphasis is on the use, management, and policy affecting the living and non-

living resources in open coastal regions, estuaries, large inland bodies of water bounded by shorelines, wetlands, and other environments associated with these resources. The program places emphasis on the development and evaluation of alternative solutions to policy and management issues at the international, national, regional, and local levels.

The Oceanographic Center is located on a 10-acre site in Port Everglades, near the entrance to the Port from the Atlantic Ocean. Its proximity to the Gulf Stream and the Florida Straits makes it an ideal location for oceanographic research. The Center's major facilities include a 20,000 square foot building which contains a large warehouse bay area, machine shop, wood shop, darkroom, electron microscope laboratory, biological laboratory, computing center, offices, the William Springer Richardson Library, and the Institute of Coastal Studies classroom and offices. Faculty and administrative offices are located on a two-story houseboat moored in the Center's boat basin. A one-story building houses a marine biology laboratory, coral workshop, and sea turtle conservation and incubation area. Large trailers house an additional biochemistry laboratory and a classroom for the Institute of Sea Survival.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director

Nova University
Oceanographic Center
8000 North Ocean Drive
Dania, FL 33004
(305) 475-7487

THE OHIO STATE UNIVERSITY

Columbus, Ohio 43210

The Ohio State University maintains teaching and research facilities in the marine and aquatic sciences and related fields at the Franz Theodore Stone Laboratory on Gibraltar Island in Lake Erie and at the main campus of the University of Columbus. The research activities in marine and aquatic sciences and related fields are coordinated through the University's Center for Lake Erie Area Research (CLEAR) with laboratories and offices at Port Clinton, Put-in-Bay, and Sandusky, Ohio, on South Bass Island in Lake Erie, and the Columbus campus.

The principal teaching facilities for aquatic sciences are located on Gibraltar Island overlooking Put-in-Bay Harbor. These facilities provide ample laboratory, classroom, and office space for the summer teaching program. The equipment supply for the program is extensive; in addition to the usual modern laboratory equipment, two large lake vessels and numerous outboard and manually propelled small boats are avail-

able. The island library provides a valuable study tool containing books, periodicals, and reprints related to all categories of aquatic science. Dormitories for students, housing for faculty and a University-operated eating facility are a part of the physical plant.

Degrees offered with emphasis in marine or aquatic sciences:

1. **B.S. and B.A.** The student, together with his/her advisor may design a baccalaureate program in one of several disciplines with emphasis on aquatic science and a balanced academic background for graduate study in marine science. The general requirements for a baccalaureate degree are:

- a) Not less than 40 quarter hours in the chosen major area;
- b) Fifteen quarter hours in each of the three basic areas of academic study: the humanities, the social sciences and the natural sciences.
- c) English, a foreign language, mathematics and/or philosophy and history;
- d) A total minimum of 180 quarter hours.

The baccalaureate degree with emphasis in and/or preparation for advanced aquatic studies may be taken in the following areas: Biochemistry, Biology, Botany, Entomology, Genetics, Microbiology, Zoology, Natural Resources, Anthropology, Geology, Civil Engineering, Chemical Engineering, and Mathematics and Science Education.

2. **Master's Degree.** The Master of Science degree may be earned in each of the above disciplines, plus Environmental Biology, Development Biology, and Biophysics.

The general requirements for the M.S. degrees as stipulated by the Graduate School of The Ohio State University are: completion of a minimum of 45 hours of graduate coursework within six calendar years with a cumulative point-hour ration of 3.0 (of 4.0) in all courses taken for graduate credit; successful completion of a final comprehensive examination; an approved thesis.

Certain of the academic areas listed above provide an alternate M.S. degree program without thesis but with more extensive graduate course requirements.

3. **Doctor of Philosophy Degree.** The Doctor of Philosophy degree may be earned in all academic areas listed above as offering the M.S. degree except Natural Resources. The general requirements for the Doctor of Philosophy Degree are:

- a) Completion of a minimum of 135 quarter hours of graduate coursework (including credit for dissertation research) beyond the baccalaureate degree, with cumulative point-hour ratio of at least 3.0 (of 4.0).
- b) A period of concentrated graduate study beyond the master's degree, at the Columbus Campus, during three of four consecutive quarters with at least 10 graduate credit hours a quarter.
- c) Successful completion of a general comprehensive examination no later than two quarters prior to the date on which the candidate expects to receive the degree.

d) Presentation of an acceptable dissertation embodying the results of an original investigation.

e) The passing of a final oral examination on the dissertation and on the immediate field of investigation.

The research unit of the aquatic and marine program at The Ohio State University is the Center for the Lake Erie Area Research (CLEAR) which maintains laboratories and offices in Columbus, Port Clinton, Put-in-Bay, and Sandusky. CLEAR serves the University as a focal point for action directed toward solutions of scientific and engineering problems of the lake as well as societal and economic conditions of the adjacent coastal zone. CLEAR's objective is to encourage and promote individual multidisciplinary research on all aspects of Lake Erie and its environs. The Center coordinates sponsored research in several major areas of man's concern, contemporary examples of which are:

1. Food resources from the lake;
2. Impact of the energy crisis;
3. Coastal zone management and erosion control; and
4. Pollution and eutrophication

The research phase of the Lake Erie Program is closely linked to instruction by providing students with financial support and stimulating topics for theses, dissertations, and other individual study efforts. CLEAR also serves as an inter-university coordination center for faculty and students from other area institutions with common interests in Lake Erie and marine studies.

Public service efforts are jointly sponsored by the instructional and research units. These services include special interest courses, conferences, seminars, workshops, publications, and advisory assistance to groups and individuals on a wide range of subjects related to Lake Erie. Advisory services are coordinated through the Ohio Sea Grant Program.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Director

Center for Lake Erie Area Research
The Ohio State University
484 West 12th Avenue
Columbus, OH 43210

or,

Associate Dean
College of Biological Sciences
The Ohio State University
484 West 12th Avenue
Columbus, OH 43210

OLD DOMINION UNIVERSITY

Norfolk, Virginia 23508

The staff of the Center for Marine Studies of Old Dominion University coordinates university-wide marine research and educational activities and is enlarging the University's involvement in marine science.

APPLIED MARINE RESEARCH LABORATORY:

Housed in 20,000 square feet of rental space adjacent to the campus, AMRL was established in 1981 to provide research facilities for faculty grants and contracts in applied marine science. Field and laboratory studies are conducted in water quality, bioassays, sediment and water chemistry, sedimentology, and marine pollution.

To obtain further information address inquiries to:

Director

Applied Marine Research Laboratory

Old Dominion University

Norfolk, VA 23508-8512

(804) 440-4692

DEPARTMENT OF OCEANOGRAPHY: The department occupies a 20,000 square foot building on the campus of Old Dominion University with eight laboratories for biological, chemical, geological, and physical oceanography. An additional marine culture facility is located across campus and houses equipment for holding and culturing fish, macroinvertebrates and plankton. A large radiogeochemistry lab supports research involving radioisotopes. Computer terminals are located in the building. The department maintains docking facilities at the Naval Amphibious Base at Little Creek, Norfolk, Virginia. A 65-foot former Army T-boat, *R/V Lindwood Holten*, has been converted for use in coastal and estuarine studies. The vessel contains oceanographic winches, a crane, sampling equipment, and laboratory facilities. Smaller vessels are also operated by the department. Investigators with requirements for larger vessels have access to those of nearby institutions.

Master of Science degrees in Oceanography are offered with the choice of emphasis in Physical Oceanography, Chemical Oceanography, Geological Oceanography, or Biological Oceanography. In order to qualify for a degree of Master of Science with a concentration in oceanography, a student must satisfactorily complete either a thesis program consisting of 32 semester hours of graduate study or a non-thesis program consisting of 38 semester hours of graduate study. The student's program must conform to the following outline:

1. Fifteen hours of basic coursework is required. This core program consists of Physical Oceanography, Chemical Oceanography, Geological Oceanography, and Biological Oceanography.

2. Participation in seminars for a minimum of two semesters is required of each degree candidate.

3. Three hours of research is required. No more than three credit hours of research may be applied to the semester hour requirement for the Master's degree.

4. Three hours of thesis is required. No more than three credit hours of thesis may be applied to the semester hour requirement for the Master's degree. (Not required for the non-thesis program.)

In order to qualify for the degree of **Ph.D. in Oceanography**, a student must pass a diagnostic examination during the first semester, a comprehensive examina-

tion at the completion of coursework, and a defense of the dissertation. Twentyfour credits of Post-M.S. coursework are required and 24 credit hours or more of dissertation work. Students who are very well qualified may be offered the option of by-passing the M.S. degree and entering the Ph.D. program after completion of at least 18 credit hours of M.S.-level work.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Graduate Program Director

Department of Oceanography

Old Dominion University

Norfolk, VA 23508-8512

(804) 440-4285

DEPARTMENT OF BIOLOGICAL SCIENCES:

The Department of Biological Sciences offers a wide based marine curriculum on the undergraduate and graduate levels. The Department has a full-time faculty of 31 with specialty areas in marine and terrestrial ecology, biomedical sciences, microbiology, and physiology. Campus facilities include the departmental location in a new Life Science Building that contains an electron microscopy suite, a radiobiology laboratory and controlled environmental rooms. Other resources are five laboratories assigned to marine courses and research, an herbarium collection of wetlands and aquatic plants, and a vertebrate museum for animals of the coastal plain. Departmental facilities include an animal holding and research facility, a greenhouse, and a biology laboratory support facility for culture and media prep needs. The Department also has four general purpose power boats, and an array of collection gear, with faculty using a variety of local vessels for coastal and shelf studies. The Department operates a fully equipped mobile field laboratory, two departmental vans, and a service truck. Off campus facilities include two field stations: one located in the Barrier Island complex, the other in the Great Dismal Swamp.

In the **Biology B.S. and M.S.** programs students may take a concentration in Marine Biology that includes course selections from a large number of specialty areas. In the **M.S.** program, the student has an option of a thesis (31 hours) or non-thesis (34 hours) tract. Course selection is coordinated by the student's advisory committee. Marine specialty areas include ichthyology, microbiology, benthic invertebrates, plankton, and wetlands plants.

The Department offers the **Ph.D. in Ecological Sciences** which includes a major tract option in Marine Biology. This program emphasizes interdisciplinary approaches to the study of environmental conditions in marine or terrestrial ecosystems. The department also has a second doctoral degree program in Biomedical Sciences.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Chairman (or Graduate Program Director)
Department of Biological Sciences
Old Dominion University
Norfolk, VA 23508-8503
(804) 440-3595

Additional marine related courses are given in the Departments of Geophysical Sciences (Geology and Meteorology), Chemical Sciences, Mathematical Sciences, Economics, and Political Science and Geography.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director
Center for Marine Studies
Old Dominion University
Norfolk, VA 23508-8512
(804) 440-3989

ORANGE COAST COLLEGE

Costa Mesa, California 92626

The Marine Science Department was formed in the Fall of 1968, with a working complement of one instructor, very little hardware, and three potential marine technicians formally enrolled in a new and experimental two-year curriculum. In May of 1971, the expanding department moved to new quarters in the recently completed Center for Applied Science. Equipment currently available for training includes a 10,000 gallon circulating marine aquarium system for display and specimen storage, a "wet" marine laboratory with cold-room capability, equipment such as spectrophotometers, pH meters, oxygen tension analyzers, water-immersion Nikon microscopes, dissection microscopes and optics; Questar optical system for long-range study, telemicroscopy, telephotography and navigation, Gilson differential respirometer, absorption spectrometer, gas chromatograph, on-line computing capability with the College's IBM System/370, two 16-foot Boston Whalers and two 23-foot SeaCraft inboard-outboard vessels for field work, dredges, water sampling equipment, instruments for lab and field use in the measurement of physical parameters such as salinity, pH, conductivity, trace elements, etc. Other equipment is planned or available on loan from other College departments on a part-time basis. The Department also purchases time on large, ocean-going research vessels when appropriate.

Degree offered: **Associate in Arts**, with specialization in Marine Technology.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Department Coordinator
Department of Marine Sciences
Orange Coast College
2701 Fairview Road
Costa Mesa, CA 92626
(714) 556-5647

OREGON STATE UNIVERSITY

Corvallis, Oregon 97331

SCHOOL OF OCEANOGRAPHY: The School of Oceanography offers only graduate degrees. Students may specialize at the master's level and the doctoral level in biological chemical, geological and physical oceanography as well as in geophysics. A program in marine resource management is available at the master's level. A joint program in air-sea interaction is available, either through the School of Oceanography or the Department of Atmospheric Sciences, at the master's level.

Research vessels are operated by the School through the facilities at the Marine Science Center in Newport (about 90 km west of Corvallis). Students may do research at the center in Newport, however most oceanography courses are normally offered only on the main campus in Corvallis.

Applicants must have an undergraduate major in an appropriate discipline and calculus. Selection of students is based on undergraduate record, graduate record examination (GRE) scores, and letters of recommendation. Foreign students are required to score 500 or better on the Test of English as a Foreign Language (TOEFL).

1. **M.A. or M.S. in Oceanography.** A minimum of 45 hours including thesis work is required for the master's program. Approximately two-thirds of the work must be taken in the School of Oceanography. In special cases, the thesis requirement may be waived.

No foreign language is required for the M.S. degree. For the M.A. degree, the student must show, by examination or by adequate undergraduate courses (not less than two years), a reading knowledge of one foreign language, usually Russian, German, or French.

Candidates must pass a two-hour final oral examination including a thesis defense.

2. **Ph.D. in Oceanography.** Credits earned in the M.S. or M.A. program may be transferred into the Ph.D. program. Ph.D. candidates are required to have the equivalent of at least three years of full-time graduate work after receiving an undergraduate (B.S. or B.A.) degree. The credit hours in a program are determined by the student's doctoral committee (five or six members of the OSU graduate faculty). A foreign language is sometimes required. Normally one year is needed for thesis work. Each candidate may be required to pass a departmental discipline examination near the end of the first year in the program. In addition, the university requires all Ph.D. candidates to pass a preliminary examination and a final oral examination (thesis defense).

3. **M.S., M.A., and Ph.D. in Geophysics.** Programs in geophysics are offered within the School of Oceanography and in cooperation with the Departments of Physics, Geology, and Mathematics. A student studying

for a degree under this program works out a course of study upon consultation with his/her committee. This program must include a minimum of two courses in oceanography. Examination procedures and foreign language requirements are the same as for oceanography degrees.

4. M.A. or M.S. in Marine Resource Management.

This program is designed to prepare students for careers in marine and coastal resource management. Each program is planned to fit the needs of the individual student. All programs include a basic set of courses in oceanography. The remainder of the programs may include courses in any or all of the following disciplines: economics, fisheries, business, geography, political science, engineering, natural sciences or other relevant fields. Most programs also include an internship. A thesis is not required. Students normally complete the program within two years. A final oral examination is required.

Applicants may have an undergraduate degree in any of the following general areas: fisheries, economics, engineering, political science, business, natural science, et al. The undergraduate work should include one year each of chemistry, calculus, and physics.

5. M.A. or M.S. in Air-Sea Interaction. This program is jointly administered by the School of Oceanography and the Department of Atmospheric Sciences. It is an integrated program, including appropriate courses in physical oceanography, atmospheric sciences, mathematics, statistics and engineering. Students may enroll either in the School of Oceanography or the Department of Atmospheric Sciences (College of Science). A final oral examination is required.

Applicants need an undergraduate degree with a major in one of the following: physics, mathematics, meteorology, engineering, or similar fields. The undergraduate work should include mathematics through ordinary and partial differential equations.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Student Advisor

School of Oceanography

Oregon State University

Corvallis, OR 97331

(503) 754-3504

OREGON STATE UNIVERSITY MARINE SCIENCE CENTER

Newport, Oregon 97365

FACILITIES AND EQUIPMENT: The Marine Science Center, a 130,000 square foot research and teaching facility operated year-round by Oregon State University, is located on Yaquina Bay, a mile from the open waters of the Pacific Ocean. The main campus of Oregon State University is 55 miles to the east of Corvallis.

The Marine Science Center has research facilities for investigations in marine fisheries, commercial fisheries engineering, aquaculture, water quality, marine biology, botany, microbiology, zoology, and oceanography. The Center is equipped with cold rooms, a freezer room, dark rooms, a data processing facility with punch card equipment and a link to the OSU campus computer, and instrument rooms housing such major items of equipment as autoclaves, centrifuges, balances, spectrophotometers, flame photometers, gas chromatographs, an atomic absorption spectrophotometer, and radiation-measuring equipment. Wet laboratories are provided with running fresh and sea water. Meeting rooms and lecture rooms are located in close proximity to the laboratories.

An ocean-going research vessel, the 54-meter *Wecoma*, is docked at the Center. The *Sacajawea*, an 11-meter vessel, is used within the bay and nearshore waters, and several small boats are available for work within the bay.

Although the Marine Science Center does not offer degrees itself, graduate and senior level courses are offered Winter, Spring, and Summer terms. Departments involved with research and teaching at the Marine Science Center are: Agricultural Engineering, Agricultural and Resource Economics, Botany and Plant Pathology, Food Science and Technology, Fisheries and Wildlife, Microbiology, Oceanography, Pharmacology and Toxicology, and Zoology.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Director

Oregon State University

Marine Science Center

Newport, OR 97365

(503) 867-3011

DEPARTMENT OF FISHERIES AND WILDLIFE: The Department of Fisheries and Wildlife is headquartered in Nash Hall on the Corvallis campus of Oregon State University. Construction of Nash Hall was completed in 1970 and contains 66,304 net square feet of space for use by the Department.

Facilities include lecture rooms, teaching and research laboratories, constant temperature rooms, self-learning center, walk-in freezer, shop, ichthyological museum, radiation laboratory, offices for staff and graduate students and numerous supporting facilities.

Research into all aspects of fisheries are carried out at the following facilities which are not located on the Corvallis campus: Marine Science Center, Netarts Bay Laboratory, Soap Creek Experimental Ponds, Berry Creek Experimental Stream, Oak Creek Laboratory, and a fish culture laboratory.

The following degrees are offered by the Department:

1. **B.S. in Fisheries Science.** All undergraduate students must complete the core courses prescribed by the Department. Additionally, non-departmental requirements include:

a) Communications	12 credits
b) Humanities	12 credits
c) Social Sciences	12 credits
d) Economics	3 credits
e) Biological and Physical Sciences	83 credits

A total of 192 term hours of undergraduate credit is required for the B.S. degree.

2. **M.S. in Fisheries Science.** All students must complete a program of study totaling not less than 45 term hours including thesis (six to nine hours) and courses approved for graduate credit. Approximately two-thirds of the work (30 term hours) must be in the major and one-third (15 term hours) in the minor. A residence of one academic year or fair equivalent is required. There is no foreign language requirement for the M.S. degree.

3. **M. Agr. degree in Aquaculture.** The Master of Agriculture degree emphasizing Aquaculture is a non-thesis degree based on coursework and a paper. The student will be required to participate in some practical aspect of aquaculture. It requires a minimum of 45 credits, no more than 21 of which can be in the major department. The remaining 24 are to be divided between two additional agriculture-related departments, with a minimum of nine in any department. Part of the major requirements is a research paper of three to five credits, registered as Reading and Conference. This degree can be completed in twelve to eighteen months.

The **Ph.D.** degree is granted primarily for attainments and proved ability. There is no rigid credit requirement. The equivalent of at least three years full-time graduate work beyond the bachelor's degree is a university requirement, but programs in this department usually take longer. At least one academic year must be spent in continuous residence at OSU with a minimum of 36 hours of graduate work. The foreign language requirement is determined by the student's doctoral committee subject to approval by the major department and the Dean of the Graduate School. A comprehensive preliminary examination is required for admission to candidacy for the Ph.D. degree. Every candidate must submit a thesis embodying the results of research and giving evidence of originality and ability in independent investigation (usually 30-45 term hours). All candidates must pass a final examination, part of which must be oral.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Head, Department of Fisheries and Wildlife

Oregon State University

Corvallis, OR 97331

DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY: The Department of Food Science and Technology is housed in two modern buildings on the Corvallis campus. These buildings contain 78,000 square feet of office, teaching and research laboratory and pilot plant space. The facilities are designed and well equipped to carry out teaching and research activities peculiar to most areas in the food field.

The Food Science Seafoods Laboratory is located at Astoria, Oregon, on the Columbia-Youngs River estuary. This research center has been operated as an integral part of the department since 1940. The facility provides 7,000 square feet of laboratory and office space and serves as a center for marine food science research.

Adjacent to the central university campus, the department operates the Food Toxicology and Nutrition Laboratory. This laboratory is especially designed for studies of toxicity, nutrition and carcinogenesis in fish. Its 5,500 square feet of laboratory and office space includes a complete histopathological laboratory and 140 separate fish rearing tanks abundantly supplied with a constant temperature water supply.

Food science and technology is the application of the sciences and engineering to the manufacture, preservation, storage, transportation and consumer use of food products. The food science program is concerned with the science and research involving the chemical, physical, biological microbiological, toxicological and nutritive properties of foods.

The University offers the following degrees in food science and technology:

1. **B.S. in Food Science and Technology.** The minimum course requirements consist of the following: Food Science and Technology, Communications, Humanities and Social Sciences, Biological and Physical Sciences, Physical Education, and electives, for a total of 192 term hours.

2. **M.S. in Food Science.** Students must complete a program of study totaling not less than 45 term hours including thesis and courses approved for graduate credit. Approximately two-thirds of the work (30 term hours) must be in the major or be composed of courses approved by the major department in the basic sciences and one-third (15 term hours) in the minor. Three credit hours of seminar are recommended with the thesis representing nine to 12 hours of major credit, which must be the result of the student's independent research and preparation. No qualifying examination is required for the M.S. degree. A final oral examination of not less than two hours is required for presentation of the student's thesis and examination of this thesis and field of study.

3. **Ph.D. in Food Science.** The degree of Ph.D. is granted primarily for attainments and proved ability and prepares the student for research in a specialized field of study. A M.S. degree or equivalent (as evaluated by the graduate faculty of the department) is required for a student who intends to work toward a Ph.D. degree. The student and his major professor formulate the Ph.D. study program. The Ph.D. program usually consists of 75 to 85 term hours beyond that required for a M.S. degree and is composed of approximately two-third's formal coursework and one-third thesis research. For the Ph.D. degree, the student's doctoral committee determines on the basis of the student's needs and the foreign language scientific literature in his field of specialization if two, one or no foreign language(s) will be required or permitted. If no foreign

language requirement is recommended by the student's doctoral committee, the foreign language requirement will be satisfied by (1) the taking of a course or courses (undergraduate or graduate) which are in subjects not usually included for credit in the major or minor and which will have as their purpose the broadening of the student or to provide a "tool" of particular value, and/or (2) a special project, other than laboratory research, which would distinctly benefit the student. Written and oral preliminary examinations are required. A thesis which is the result of the student's independent research and preparation is required to demonstrate an independent research capability. The candidate is expected to defend his thesis and knowledge of his field in a final oral examination.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Head, Department of Food Science and Technology

Oregon State University

Corvallis, OR 97331

(503) 754-3131

SCHOOL OF ENGINEERING: The School of Engineering has a variety of specialized laboratories and complementary facilities for use in the ocean engineering research and training programs. The following major facilities are used for student training and research needs: environmental fluid dynamics laboratory wave basin, hydraulic laboratory, fluid measurements laboratory, hydrologic facilities, marine science center engineering laboratory, sanitary engineering laboratories, photogrammetry laboratory, soil mechanics laboratory, structural engineering laboratory, engineering materials laboratory, mechanical engineering laboratory, instrumentation laboratory, electrochemical engineering laboratory, underwater acoustics laboratory and simulation laboratory.

The computer center, oceanography laboratories, radiation center and Marine Science Center are also extensively used in the ocean engineering program, together with vessels of the Oceanography School and facilities of the Pacific Northwest Water Laboratory of the Environmental Protection Agency.

The principal research areas for studies on estuarine hydraulics, water resources and ocean engineering are the rivers, lakes, reservoirs, estuaries, and coast of Oregon. Where convenient, temporary field research offices have been established; in other cases, departmental vehicles and ocean engineering boats (six craft up to 25 feet long) have provided temporary instrument shelters for environmental research.

Graduate study in ocean engineering is offered at Oregon State University through the School of Engineering. This program of study leads to the degrees of **Master of Ocean Engineering** or **Master of Science** and **Doctor of Philosophy** in engineering with an emphasis on ocean engineering. The graduate student in ocean engineering, depending on his specific interests, is admitted to an established department in the School of

Engineering: civil, chemical, electrical, industrial, mechanical and metallurgical or nuclear engineering. A program of study is then designed to fit the individual's professional objectives and to achieve a high degree of engineering competence related to the ocean environment. The following requirements are to be met in obtaining a degree through the ocean engineering program:

1. Major: An area of ocean engineering specialization within one or more of the established engineering disciplines.

2. Minor: Supporting coursework in ocean engineering and/or oceanography plus other appropriate courses to prepare the student for professional work in the ocean-oriented industries and agencies.

3. Thesis research: Each student must conduct research and prepare a thesis on a pertinent subject concerning engineering in the marine environment.

4. Program of study: The program must meet approval of the ocean engineering committee of the School of Engineering.

The **Ph.D. program** requires at least three years of study beyond the baccalaureate degree and includes about 135 quarter credit hours of course and thesis work. The Master of Ocean Engineering and the Master of Science in Engineering degrees require 45 quarter credit hours, including research.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Assistant Dean

School of Engineering

Oregon State University

Corvallis, OR 97331

PENINSULA COLLEGE

Port Angeles, Washington 98362

The College is located only one mile from the Strait of Juan de Fuca, has four large lakes within 15 miles, and state fish hatcheries and rearing ponds nearby.

The fisheries complex contains one classroom, one lab-classroom, office for two instructors, an equipment room, museum, workshop, and small fish hatchery. Numerous small boats are available. Field projects and work with state and federal agencies is emphasized.

The degree of **Associate of Applied Sciences (Fisheries Certificate)** is offered.

FISHERIES TECHNOLOGY: This program prepares a student to perform assignments as a scientific or biological aid under the direction of a fisheries biologist. Completion of the curriculum specified in the catalog (or equivalent) qualifies the student for the fisheries certificate and the AAS degree.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Director, Vocational Education
Peninsula College
1502 East Lauridsen Boulevard
Port Angeles, WA 98362
(206) 452-9277

**THE PENNSYLVANIA
STATE UNIVERSITY**
University Park, Pennsylvania 16802

The following specialized facilities are available at the University: laboratories in marine geology, special meteorological equipment for courses in marine meteorology, and a laboratory for underwater acoustics. In addition, the University is a member of the Marine Science Consortium, and through the Consortium has access to facilities at Wallops Island, Virginia.

No formal degree programs are offered in marine science; however, a marine science minor is available to students in allied major fields. Baccalaureate and advanced degrees are offered in the allied fields of geological sciences (geology, geophysics, mineralogy, and geochemistry), meteorology, geography, biology and physics. Students who are candidates for degrees in these disciplines can schedule certain courses in the marine sciences.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Marine Science Committee
The Pennsylvania State University
117 Old Main
University Park, PA 16802

PIERCE COLLEGE
Woodland Hills, California 91371

Pierce College is one of nine community colleges in the Los Angeles Community College district, and as such, grants an **Associate of Arts degree** with an emphasis in oceanography. Classroom and laboratory experience is supplemented by field work and ship time. Pierce College does not own its own research vessel, but utilizes the *R/V Vantuna* of the University of Southern California for research purposes.

At the present time work is underway to construct a new building to accommodate the audio/tutorial biological laboratory program at Pierce. This is a unique program whereby the student can schedule his own time via audio/visual presentations of lectures and laboratories.

As of Fall, 1982, 72 declared majors in Oceanography were working toward the A.A. degree at Pierce. The program is geared to the student who is planning to go on to complete a degree in oceanography at a four-year institution, rather than the more vocationally oriented 2-year programs for marine technicians.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman, Earth Science Department
(or Biological Science)
Pierce College
6201 Winnetka Avenue
Woodland Hills, CA 91371
(213) 347-0551

POMONA COLLEGE
Claremont, CA 91711

Facilities for undergraduate study in marine science include the undergraduate teaching and research laboratories in biology, geology and physics. Research equipment includes apparatus for analyzing chemical and physical properties of the marine environment, such as oxygen and other dissolved gases, salinity, chlorinity, specific ions, trace nutrients, and pH; centrifuges, including a continuous-flow centrifuge; osmometers; spectrophotometers; flame photometers; equipment for x-ray diffraction, x-ray fluorescence spectrography, electron microprobe analysis, and atomic absorption analysis; gas and liquid chromatography including HPLC; electron (SEM, TEM), phase-contrast, fluorescence, compound, and dissecting microscopes; photography equipment, including an underwater Nikonos camera and complete darkroom facilities; walk-in constant temperature and controlled-environment rooms; a recirculating sea-water aquarium system with nine 35-gallon aquaria, two 250-gallon capacity storage tanks, and filtration and cooling units. A well-equipped shop is available for construction of specialized equipment, including electronics. An IBM 4341 computer supports some 37 terminals and printers distributed in clusters throughout the campus. Both students and faculty have unlimited use of the computer in teaching and research.

Field equipment available includes a variety of small boats, plankton nets, biological grabs and dredges, water samplers, etc. The nearby Bernard Field Station of the Claremont Colleges includes a small artificial lake useful for developing techniques for sampling and studying aquatic habitats. There is ready access to the *R/V Vantuna*, an 85-foot tuna clipper equipped with a wide variety of equipment for research and teaching in biological, physical, chemical, and geological oceanography.

Pomona College is a four-year liberal arts college, offering the **Bachelor of Arts** degree in a number of fields. In the sciences, basic background and broad knowledge are emphasized, rather than specialization in particular narrow fields. About four to six students each year graduate with a B.A. degree in fields related to marine science and go on to graduate study. In addition to the more standard concentrations in biology, geology and physics, special concentrations such as environmental sciences, biology-mathematics and

marine biology have been arranged for individual students. Thirty-two courses (128 semester hours) are required for the B.A. degree, with distribution depending on the concentration chosen. Usually about one-fourth to one-third of the program must be within the major field and closely related fields.

Curriculum offered: available in school catalog.
 Faculty appointments: available in school catalog.
 To obtain further information, address inquiries to:
 Coordinator
 Marine Biology Program
 Biology Department
 Pomona College
 Claremont, CA 91711
 (714) 621-8000 x2950 2993 2948

PRINCETON UNIVERSITY

Princeton, New Jersey 08544

The principal facilities are the geological, paleontological and geophysical laboratories of the Department of Geological and Geophysical Sciences, and the Geophysical Fluid Dynamics Laboratory of NOAA on the Forrestal Campus. Princeton University is a member of the New Jersey Marine Sciences Consortium with teaching and research laboratories and small boats at the Sandy Hook Marine Laboratory and the Seaville Field Station.

The following degrees are offered:

1. **A.B. in Geology.** Normally 12 one-term courses in a department or related fields, and a senior thesis. Recipients per year: 20.

2. **B.S.E. (Geological Engineering).** Normally 12 one-term courses in engineering, geology and related sciences, and a senior thesis. Recipients per year: 10.

3. **Ph.D. in Geology.** Completion of one year of residence, passing general examination, and completion and defense of dissertation. Recipients per year: 6.

Curriculum offered: available in school catalog.
 Faculty appointments: available in school catalog.
 To obtain further information, address inquiries to:
 Chairman, Department of Geological and Geophysical Sciences
 114 Guyot Hall
 Princeton University
 Princeton, NJ 08544

RICE UNIVERSITY

Houston, Texas 77001

Rice's current activities in marine science range from wetlands research in the near-shore environment to open ocean micropaleontological, sedimentological and geophysical research. Most of the activity is in the Gulf of Mexico, Caribbean, and the Antarctic, but prob-

lems from around the world are underway and others planned. The Department of Geology is equipped with laboratory facilities and oceanographic instrumentation mainly for programs in oceanic micropaleontology (studies on Radiolaria and Foraminifera), trace fossil studies, coral studies, land use studies, and marine geophysics. To this end the facilities in the Geology Department include two sedimentation labs, a micropaleontology lab with all major microfossil catalogues, a paleobiology laboratory, and a geophysics laboratory. These labs are adequately equipped, and marine collecting equipment includes a variety of plankton collecting devices, coring equipment, geophysical equipment, etc. The University does not maintain a research vessel but ship time is customarily available on a variety of research vessels operated by other institutions, and a number of cooperative projects are currently underway. The Department of Biology is active in wetlands and estuarine research and is equipped for such undertakings. The Department of Mechanical Engineering is active in ocean engineering research problems and is equipped for such undertakings.

The following degrees are offered:

1. **B.S. in Mechanical Engineering** with option in Ocean Engineering, through the Department of Mechanical Engineering.

- a) 134 semester hours total
- b) At least 42 semester hours on an advanced level (300 or higher)
- c) Two years math, one year physics, and one year chemistry plus recommended courses.

2. **M.S. in Mechanical Engineering** with option in Ocean Engineering, through the Department of Mechanical Engineering.

- a) Fifth-year program
- b) Ten advanced courses (300 or higher), at least four courses 500 or above and four for additional professional concentration

3. **Ph.D. in Mechanical Engineering** with option in Ocean Engineering, through the Department of Mechanical and Aerospace Engineering.

- a) Normally three or more years of study are required
- b) At least two years of full-time study, or the equivalent of 60 semester hours in residence at Rice
- c) Pass public oral examination
- d) Approved thesis

4. **M.A. in Geology**, through the Department of Geology.

- a) 30 semester hours, 24 of which must be in residence at Rice (includes thesis)
- b) Thesis and thesis defense

5. **Ph.D. in Geology**, through the Department of Geology.

- a) Sixty semester hours, in residence at Rice (includes thesis)
- b) Language
- c) Candidacy exam
- d) Thesis and thesis defense.

6. **M.A. in Biology**, through the Department of Biology. (Same as above in Geology).

7. **Ph.D. in Biology**, through the Department of Biology. (Same as above in Geology).

COOPERATIVE PROGRAM IN GEOPHYSICS AND MARINE SCIENCE: A cooperative program exists between Rice University and The University of Texas, Marine Science Institute, Galveston. Programs for advanced study may be worked out by contacting either the Rice Geology Department or the Marine Science Institute, Galveston, Texas.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Chairman

Department of Geology (Biology)

Rice University

Houston, TX 77001

or,

Director

Galveston Geophysical Laboratory

Marine Science Institute

The University of Texas

Galveston, TX 77550

ROGER WILLIAMS COLLEGE

Bristol, Rhode Island 02809

Roger Williams College's main campus is in Bristol, Rhode Island with approximately 800 feet of shoreline on Mount Hope Bay, a portion of Narragansett Bay. A wide variety of marine environments are within 10 miles of the campus including water depths of over 150 feet, rocky ocean shorelines, tidal marshes, estuaries with a wide variety of salinities, and a wide variety of bottom types. Waters near the campus range from heavy pollution with both industrial and human waste to relatively pollution free ocean waters. Generally, small classes of six to 15 students in upper level courses make field work, laboratory work and special projects an important part of the curriculum. A paper or other evidence of the student's ability to conduct investigation, use library resources and write a report is usually required in each upper level course.

Physical facilities used by students taking courses related to marine science include six laboratories, one preparation room, one instrument and storage room, dark room, an audio-tutorial laboratory and numerous classrooms and lecture halls, library, dining hall and dormitories. Staff members include scuba divers and a licensed boat captain. The Marine Program utilizes a 20-foot johnboat for most laboratory investigations. Equipment includes various mesh size plankton nets, seines, NMR, atomic absorption unit, spectrophotometers, microscopes including binocular phase types, water sampling equipment, three small refrigerated sea water tanks, photographic equipment, a flame photometer, refrigerated centrifuge, electrophoresis and

chromatography equipment, pH meters, environmental chambers and a gas chromatograph. A new micro computer has been added for student use in their interpretation of data.

The following degrees are offered:

1. **B.A. and B.S. degree in Biology** with an opportunity to concentrate in molecular and cellular, organ and organismal biology, field biology, and horticulture.

2. **B.A. or B.S. degree in the Marine Sciences.**

CO-OP PROGRAMS: Cooperative Education programs are available to students. In the past several years, individuals have been working under the Co-op Program with National Marine Fisheries; state and local environmental groups and various industries. The student has found that the field experience has been of extreme value while obtaining college credit.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Natural Science Division

Roger Williams College

Bristol, RI 02809

(401) 255-2165

RUTGERS - THE STATE UNIVERSITY OF NEW JERSEY

New Brunswick, New Jersey 08903

Modern laboratory facilities in the basic sciences are available on the three city campuses at New Brunswick, Camden, and Newark, New Jersey. In addition, the University operates several small laboratories on the New Jersey coast involved with various aspects of shellfish research and a large laboratory on Great Bay which is designed to work on the full range of marine inquiry. A 62-foot research vessel was recently acquired and will work out of the Great Bay Station. A 40-foot research vessel, based at one of the laboratories on Delaware Bay, operates year-round, providing facilities for power dredging, hydrographic sampling, etc, within the estuary. A small fleet of outboards is available for a variety of studies in the coastal bays and sounds, throughout the length of the State. An ancient houseboat laboratory is another base for summer work in one of the estuaries. The research programs underway in these laboratories provide coastal marine experiences for approximately 25 students annually.

Undergraduate students planning to do advanced work in the marine sciences usually major in one of several undergraduate degree programs such as Biology, Geology, Environmental Science, Chemistry, etc.

At the graduate level no degree program is specifically labeled "marine," but graduate students in *Ph.D. programs* in Zoology, Botany, Environmental Science, Ecology, Microbiology, Geology, etc., can gain marine experience in the coastal research programs underway here.

A new **Ph.D. program in Geophysical Fluid Dynamics** is now offered through the cooperative efforts of the Department of Mechanical and Aerospace Engineering and the Department of Meteorology. Teaching and research concentrate on fluid dynamics problems of the geosphere, i.e., on meteorological and oceanographic fluid dynamics and related problems. The program draws on research and graduate courses in the fields of meteorology, engineering, mathematics, information sciences and others as necessary. Specializations available within the program include meteorology, physical oceanography, upper atmosphere dynamics, air pollution, turbulence, turbulent dispersion, and rotating and stratified flow.

Students select from courses in meteorology, physical oceanography, mechanical and aerospace engineering and related graduate offerings.

Rutgers has established the Marine Sciences Center as a research arm of the University. The Center will interact with the variety of departments on campus but will not develop its own curriculum at this time. Rather, faculty and students will work through the Marine Sciences Center while retaining their affiliations with their academic departments.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director
Marine Sciences Center
Rutgers — The State University of New Jersey
New Brunswick, NJ 08903
(201) 932-3080

ST. JOHN'S UNIVERSITY Jamaica, New York 11439

The University offers marine science courses at the Queens campus. The science building opened in 1958. The departments of biology, chemistry and physics and the College of Pharmacy are located in this building which contains complete laboratory and classroom facilities for instruction and research. The marine waters of Long Island Sound, Jamaica Bay, Great South Bay and the Atlantic Ocean are easily accessible for collecting samples and specimens.

The following degrees are offered:

1. **Ph.D. in Biology** (Department of Biology). The course requirements are determined by a special faculty committee on the basis of the professional objectives of the individual student. A minimum of 69 semester hours of graduate coursework beyond the bachelor's degree or a minimum of 36 semester hours beyond the master's degree must be taken in the program. The student must also demonstrate an ability to read two of the following languages: French, German or Russian.

2. **M.S. in Biology** (Department of Biology). A minimum of 33 semester hours of graduate courses beyond

the bachelor's degree must be taken in the program. At present there is no formal dissertation or language requirement for this degree.

3. **B.S. in Biology; B.S., B.A. in Environmental Studies.** This is the regular program for biology majors who may elect to take some courses and research in marine biology and related subjects.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman
Department of Biology
St. John's University
Grand Central and Utopia Parkways
Jamaica, NY 11439

SALEM STATE COLLEGE Salem, Massachusetts 01915

Salem State College, founded in 1854, is a multi-purpose institution located on a 27-acre campus, two miles from the center of Salem and 20 miles from Boston.

The ocean and marshes of Massachusetts's North Shore, where Salem State is located, provide a unique and immediately accessible learning environment for students who choose to work toward a *Bachelor of Science degree in Biology* with a concentration in Marine Biology.

Students in any *Bachelor of Arts or Science* degree seeking program are eligible to select a program that allows for a minor in Marine Studies. The Marine Studies minor provides courses which allow students to explore areas of special interest in marine studies and provides curricula which acquaints the individual with both the humanitarian and technological aspects of marine environments.

In addition to coursework, general science laboratories are available for research, as well as the natural habitats in the surrounding area. Salem State College is part of a collaborative program with other nearby institutions, and has access to research vessels through cooperative efforts with these institutions.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairperson
Department of Biology
Salem State College
Salem, MA 01915
(617) 745-0556

or,

Chairperson
Department of Interdisciplinary Studies
Salem State College
Salem, MA 01915
(617) 745-0556

SAN DIEGO COMMUNITY COLLEGES

Mesa College, San Diego, California 92112
Evening College, San Diego, California 92101

These colleges each offer a two-year program leading to either an *Associate of Science* degree or certificate in Marine Technology. Shop facilities are utilized for practical instruction in refrigeration, welding, propulsion machinery, drafting and other allied industrial arts that have relevance to marine work. Biological, physical and chemical laboratories are used for class-work needed to develop skills related to basic tasks needed in the marine environment. Initially, instruction began in 1967 and the full program began in 1969. A wide range of marine science, ocean engineering and business enterprises are carried on in San Diego, and many of these are frequently visited in the course of field trips. Vessels are chartered for all-day at-sea instruction. A shoreside technology institute jointly administered by a county-wide alliance of higher education institutions is to be designed in 1984.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Coordinator, Vocational Education

San Diego Community College District

3375 Camino del Rio South

San Diego, CA 92108

SAN DIEGO STATE UNIVERSITY

San Diego, California 92182

The Marine Studies Program at San Diego State University is a multidisciplinary program offered by departments in the natural sciences, engineering, economics, geography, political science, and other fields. More than 70 faculty members are involved in the program. The Center for Marine Studies coordinates the program and provides supporting services to the faculty, staff, and students involved. Services provided by the Center include advising students concerning marine studies and employment opportunities, assistance to faculty and students, and support of the SDSU Diving Safety Program.

All participating science departments have modern, well-equipped classroom, laboratory, and shop facilities, including standard physical and biological oceanographic equipment, laboratories for the analysis of seawater and sediment characteristics, radioisotope and electron microscope facilities, computer facilities, constant temperature rooms, and experimental aquarium laboratories. Library holdings are well-represented in the area of marine studies. The extensive libraries of the Scripps Institution of Oceanography and the National Marine Fisheries Service at La Jolla are readily accessible. The SDSU Marine Laboratory is located adjacent to Sea World on Mission Bay. Re-

search facilities at Sea World are available through cooperative arrangements with the Hubbs-Sea World Research Institute. Specialized laboratories for research in aquaculture and thermal effects are operated by SDSU at the Scripps Institution of Oceanography and the San Diego Gas & Electric Company's Encina Power Plant in Carlsbad, California.

Boat facilities are maintained on Mission Bay, where seven small craft are available for coastal sampling operations. The *Laura C.*, a 30-foot research boat, is used in conjunction with the Hubbs-Sea World Research Institute. It is equipped with a recording fathometer, radar, Loran C., radio direction finder, hydrographic and trawling winches, an "A" frame, and a cabin with laboratory space and berthing for 4-6 persons. The use of larger oceanographic vessels and some specialized laboratory facilities are arranged in cooperation with the Scripps Institution of Oceanography, the National Marine Fisheries Service, and other university, state and federal laboratories.

By choice of the faculty, SDSU does not offer separate degrees in Oceanography or Marine Studies. Instead, students emphasize marine studies within the traditional departmental degree programs through advanced, marine-related course work and research. Courses in general oceanography are offered by the College of Sciences under an Oceanography listing (see General Catalog), with the cooperation of faculty from the Departments of Geological Sciences, Chemistry, Natural Science, Biology, and Zoology. Advanced course work and research in geological and physical oceanography are conducted in the Geological Sciences Department. An option in marine geology is offered as part of the undergraduate major in Geological Sciences. The Chemistry Department offers work in chemical oceanography. Advanced courses and research in biological oceanography and marine biology are conducted in the life sciences departments. An oceanography minor is offered for all undergraduate science majors through the Department of Geological Sciences. Similar marine-related coursework and research are offered in the Departments of Economics and Geography and in the School of Engineering.

The following degrees are offered with emphasis in Marine Studies:

1. **A.B. and B.S. in Biology, Botany, Chemistry, Geological Sciences, Microbiology, Physics and Zoology; B.S. in Civil and Mechanical Engineering; A.B. in Geography and Economics.** All students are required to fulfill the general education requirements of the university and to complete a series of core courses in their major field and in related areas of science and mathematics. Students are encouraged to obtain practical research experience through senior investigation and special studies courses. An option in Marine Geology is available to Geological Sciences majors and a minor in Oceanography is available to all science majors.

2. **M.A. and M.S. in Biology, Chemistry and Physics; M.S. in Geological Sciences, Microbiology and in Civil**

and Mechanical Engineering; M.A. in Geography and Economics. All students are required to obtain research experience and to demonstrate competence in their major field. They must also complete examinations and research leading to a thesis.

3. Ph.D. in Chemistry, Ecology and Genetics, offered jointly with the University of California. In order to qualify for this program the student must be admitted to regular graduate standing by the University of California and SDSU. The student must be prepared to take orientation examinations covering the specific fields in each discipline that are administered by a joint guidance committee. After formal admission to the program, the student must spend at least one year in full-time residence in each of the two campuses. A dissertation on a subject chosen by the student related to his field of specialization, demonstrating his ability to conduct independent research, is required of all candidates. A joint doctoral committee, consisting of faculty members from each institution, conducts the qualifying and final oral examinations and guides the research. The degree is awarded jointly by the participating institutions.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director

Center for Marine Studies

San Diego State University

San Diego, CA 92182-0408

(619) 265-6523

SAN FRANCISCO STATE UNIVERSITY

San Francisco, California 94116

The Lake Merced campus of San Francisco State University houses a complete and modern educational community. In addition to the well-equipped classrooms and laboratories, there are numerous specialized instructional rooms, a large library and audio-visual center, two theaters and a wide range of recreational and athletic facilities. Recently completed buildings greatly enhance the University's capabilities in the science disciplines. Building in the planning stages will include more classroom space for the humanities and education. In addition to activities at its San Francisco site, the University participates in three off-campus activities: The Tiburon Center for Environmental Studies, the J. Paul Leonard Sierra Nevada Science Field Campus, and the Moss Landing Marine Laboratories. The University also operates an extension program serving more than 3,000 students as well as conducting short courses, conferences, institutes and workshops.

The following degrees are offered:

1. Master of Arts in Biology: Concentration in Ma-

rine Biology. The general requirements of all students are as follows:

a) Thirty units of upper division and/or graduate credit (may include up to six units of experimental courses in Biology)

b) A minimum of 16 units of credit in graduate-level courses

c) A minimum of two department seminars

d) Graduate English Proficiency Test

Two alternates for the M.A. degree are available.

1. M.A. by research and thesis. 30 units of required coursework plus acceptable thesis and an oral defense of thesis research.

2. M.A. by research and examinations. Requires a maximum of four units of Biology research; a written examination taken during the student's first or second semester (which may be repeated with a three-semester time limit for satisfactory passage); a comprehensive oral examination (unacceptable portions may be repeated once).

The Marine Biology Program offers the Master of Arts degree in Biology with a concentration in Marine Biology. Programs in this area reflect the fact that Marine Biology is a meeting place for all the biological sciences and some of the physical sciences. Graduate work may be broad or follow specific program areas as ecology, systematics, functional morphology, physiology and ethology.

The marine program and facilities of San Francisco State University are strongly supported by the Moss Landing Marine Laboratories, a modern seashore laboratory which is operated cooperatively with four other State Universities.

Students interested in study through this program are urged to observe the general requirements in the Bulletin as well as the specific requirements stated here and, more fully, in the Marine Biology catalog which is available from the Program Office upon request.

The applicant must have the equivalent of the Bachelor of Arts degree in the Department of Marine Biology at San Francisco State University or the approval of the Marine Biology advisor.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Dean, School of Science

San Francisco State University

San Francisco, CA 94132

SAN JOSE STATE UNIVERSITY

San Jose, California 95192

San Jose State University is part of the California system of higher education. It is the oldest of such institutions in the State, established over 120 years ago. It is located in San Jose, at the southern end of San Francisco Bay, approximately 50 miles southeast of

the city of San Francisco, and about 30 miles inland from the Pacific Ocean.

The undergraduate program leading to the *Bachelor's degree in Meteorology* began at San Jose State University in 1960, and the Master's degree in Meteorology program was inaugurated in 1964. The primary function of the meteorology program is to train the student for a professional career in meteorology. The four year program leading to the Bachelor's degree provides graduates with the knowledge and training needed for work with various industrial concerns, aviation companies, and government agencies such as the National Oceanic and Atmospheric Administration, U.S. Forestry Service, various air pollution agencies, the armed forces, and the Federal Aeronautics Administration. The program leading to the Master's degree provides the student with greater competency in theoretical and applied meteorology in order to qualify him or her for research work and higher levels of professional responsibility and the necessary background for further study in a Ph.D. program.

These programs of instruction are complemented by a growing research endeavor. Present studies are primarily directed towards solution of practical problems in applied meteorology; however research of a more theoretical nature is not overlooked. Among the current investigations are studies of air pollution, the wind circulation in the San Francisco Bay area, relationships between weather and health, stratospheric circulations, urban climate studies, atmospheric gravity waves, ocean-atmosphere interactions, cloud physics, and agricultural meteorology.

Special facilities of the department include: (1) A large meteorological observatory, equipped with diverse instrumentation, such as radar, radiosonde, air pollutant sampling devices. An automatic data acquisition system is installed. (2) A complete synoptic laboratory, including teletypes, facsimile, satellite picture receiving system, microfilm library, etc. (3) a marine laboratory on the Pacific Coast (Moss Landing), including a vessel for oceanographic studies. (4) A mobile micro-meteorological laboratory with an automatic data acquisition system. (5) Two mobile radar tracking systems, each equipped with automatic data acquisition systems. (6) A small departmental computer system (apart from the campus computer center). (7) A small instrumented aircraft for mesoscale studies. (8) Hydrodynamics laboratory. (9) A cloud physics laboratory is being developed. (10) Mt. Sutro Meteorological Tower; an 80-foot TV tower atop an 800-foot hill in the center of the City of San Francisco has been instrumented to study internal gravity-shear waves in the west coast inversion, the structure of fog, depletion of radiation in the marine layer, and vertical profiles and fluxes of pollutants. Instruments for measurement of wind, temperature, humidity, pressure, net and total radiation, ozone and carbon monoxide concentrations, and cloud droplet characteristics have been installed at six levels. (11) Satellite data depository for Western U.S.A.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman
Department of Meteorology
San Jose State University
San Jose, CA 95192
(408) 277-2311

SANTA BARBARA CITY COLLEGE

Santa Barbara, California 93109-9990

Santa Barbara City College offers a two-year vocational program in Marine Diving Technology with emphasis on contemporary commercial diving.

The program consists of three types of courses. The first is designed to develop the skills and knowledge required of a diving technician. The second series of courses is designed to give students an understanding of the environment in which they will be working. The third type consists of general education courses to increase the student's knowledge and communicative ability.

Successful completion of the program qualifies graduates for a *Certificate of Completion* or an *A.S. Degree* and employment in a variety of jobs mainly centered in the commercial diving industry.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Department Chairman
Marine Diving Technician Program
Santa Barbara City College
721 Cliff Drive
Santa Barbara, CA 93109-9990
(805) 965-0581 x426

SEA EDUCATION ASSOCIATION

Woods Hole, Massachusetts 02543

The Sea Education Association offers Sea Semester, a one-semester undergraduate program in oceanography, nautical science, and maritime studies. It is a rigorous academic, scientific and practical experience designed to form a regular part of a college undergraduate education. Courses are taught at the Sophomore/Junior level. Students spend the first half of Sea Semester (the six week Shore Component) in Woods Hole, Massachusetts, receiving instruction in oceanography, nautical science and maritime studies. They then go to sea for the second half of Sea Semester (the six week Sea Component) aboard the *R/V Westward* for practical laboratory experience. There are six sessions each year, a new one beginning about every two months.

No degree is granted. The more than 80 colleges and universities which accept 17 semester hours of transfer credit from Boston University upon successful completion of Sea Semester include: Williams, Princeton, Reed, Stanford, Kenyon and the University of Michigan, Cornell, University of Pennsylvania and Colgate, among others, grant credit directly from their registrars.

During the Shore Component students study the characteristics and processes of the global ocean. Oceanographic concepts are introduced and developed from their bases in biology, physics, chemistry and geology. Prerequisite: One semester of a college laboratory course in a physical or biological science or its equivalent. This is designed to provide a broad background in oceanography. In addition, students are required to specialize by developing individual research projects in their own area of interest which are then carried out on the subsequent *Westward* cruise. Guest lecturers drawn from the Woods Hole research community provide insight into current trends and activities in this rapidly evolving field. Additionally, students undertake a multidisciplinary study of the history, literature, and art of our maritime heritage, and the political and economic problems of contemporary maritime affairs.

Students are also introduced to the technologies of operation at sea. The concepts of navigation (piloting, celestial and electronic), naval architecture, ship construction, marine engineering systems, and the physics of sail are taught from their bases in astronomy, mathematics and physics. Prerequisite: One semester of college mathematics or its equivalent. The course provides the theoretical foundation for the operation of the *R/V Westward* at sea.

Students may take the Shore Component alone, for nine credits, without enrolling in the Sea Component. The Sea Component complements the theoretical and intellectual understanding of the oceans introduced in the Shore Component with the practical skills which only actual experience at sea can provide.

Instruction at sea includes lectures and laboratory exercises designed mainly to develop a better understanding of oceanography and related subjects to which students are introduced ashore. Topics treated vary with the cruise track but include attention to all of the major subdisciplines of oceanography. Two hours each day are devoted to lectures, examinations, reports and other class-related activities. In addition, students spend eight hours each day on watch, receiving instruction and assuming progressively increasing responsibilities for oceanographic research and attendant vessel operations. Periodically, visiting scientists from government and university laboratories provide additional expertise and instruction in the process of their own research work.

Each Sea Component consists of a basic and an advanced laboratory course. In the basic course, theories and problems raised in the Shore Component are tested in the practice of oceanography at sea. Students are

introduced to the tools and techniques of the practicing oceanographer. During two lectures daily and during watch standings, students are instructed in the operation of basic oceanographic equipment, in the methodologies involved in the collection, reduction, and analysis of oceanographic data, and in the attendant operations of a sailing oceanographic research vessel. In the advanced course, students assume increasing responsibility for conducting oceanographic research and the attendant operations of the vessel. Ultimately, the individual student is responsible directly to the Chief Scientist and the Master of the vessel for the safe and orderly conduct of research activities and related operations of the vessel. Each student undertakes an individual research project designed during the Shore Component.

The *R/V Westward* is a 125-foot staysail schooner which is operated in waters of the western North Atlantic, Caribbean Sea, and Gulf of Mexico, making annual transects between Newfoundland and the South American coast. Designed for deep-sea instruction and research, *Westward's* laboratory is equipped with modern sampling and analytical gear for research on physical, chemical, geological, and biological oceanography to a depth of 3000 meters.

Curriculum offered: available in catalog.

Faculty appointments: available in catalog.

To obtain further information, address inquiries to:

Dean

Sea Education Association

Box 6 M

Woods Hole, MA 02543

(617) 540-3954

SEATTLE CENTRAL COMMUNITY COLLEGE

Seattle, Washington 98107

The Seattle Central Community College offers the *Associate of Applied Science* degree in three two-year programs.

MARINE CARPENTRY: The Marine Carpentry Program develops basic skills for entry (apprentice) level into the boatbuilding trade. Training in the construction and repair of boats includes both wood and fiberglass technology. The Marine Carpentry course includes instruction in joiner-work, lofting and layout, planking and related technical information. Length of a class is five to eight quarters (depending on student ability). The Marine Carpentry Program develops entry level skills for employment in the boatbuilding and boat repair trade.

MARINE DECK TECHNOLOGY: The Marine Deck Technology Program offers the opportunity for students to acquire the knowledge and skills necessary for the operation and maintenance of commercial vessels. It is

mainly oriented towards those sea-going occupations found on fishing boats, tugboats, and ferry boats. Training is accomplished through a combination of classroom and "hands-on" experience in shops and vessels. Successful completion of this U.S. Coast Guard approved two-year course will be credited by the government toward the sea service requirement for an appropriate Federal Merchant Marine Mate's license.

MARINE ENGINEERING TECHNOLOGY: The Marine Engineering Technology program emphasizes the training necessary for the efficient operation and maintenance of sea-going vessels. Training consists of laboratory experiments and shipboard operation and maintenance. Career opportunities include employment in vessel operation, vessel maintenance and repair, ship operations management, and as marine engineering aides.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director, Marine Technology Program
Seattle Central Community College
1701 Broadway
Seattle, WA 98122
(206) 587-3800

SEATTLE PACIFIC UNIVERSITY

Seattle, Washington 98119

The University offers Marine Biology courses at its main campus in Seattle, Casey Campus on Whidbey Island and at its field station on Blakely Island. The Casey Campus encompasses more than 100 acres of wooded lands, with a mile of private beach facing the straits of Juan de Fuca. Accommodations include barracks, kitchen and dining facilities, classrooms and a seawater laboratory. A small field station with laboratory, dining and housing facilities for 25 students and faculty is under development. The field station will be used for research and field studies in Marine Biology. Summer programs in Marine Biology are offered each year. The Casey Campus is used extensively by public schools during the academic year for outdoor education programs.

The *B.S. in Biology* is offered by the University. All students are required to take general Biology, Genetics, Ecology, Developmental Biology, Cell Biology, Seminar and 20 additional quarter hours in upper-division Biology. Chemistry through organic is required.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director
Marine Biology Program
Seattle Pacific University
Seattle, WA 98119

SHELDON JACKSON COLLEGE

Sitka, Alaska 99835

Sheldon Jackson College has marine science teaching facilities on its campus located at Sitka on Baranof Island in southeast Alaska. The physical facilities include a freshwater-seawater laboratory and indoor and outdoor salmon hatchery incubation capacity for 12 million eggs or alevins. Physical, chemical and biological sciences share the same building located on the Pacific seashore as well as modern teaching laboratories built and equipped within the last four years. In addition, the College owns a 38-foot, twin engine cabin cruiser, an 18-foot Boston Whaler with an 80 horsepower outboard motor, a 16-foot Livingston with 80-horsepower outboard motor, and several smaller skiffs. Numerous teaching and research equipment is available for study of marine and freshwater environments. Practical experience is emphasized in the hatchery and field technician training courses for fisheries students.

The following degrees are offered:

1. **A.S. in Science**, specializing in Fisheries and Aquaculture. Two years, 64 semester credits.
2. **Two-year Certificate in Fisheries Technology.**
 - a) Two years, 64 semester credits
 - b) Includes requirements of one-year certificate
3. **One-year Certificate in Fish Culture Technology.**
 - a) One year, 34 credits
 - b) Includes late summer salmon spawning experience

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Academic Dean
Box 479
Sheldon Jackson College
Sitka, AK 99835

SHORELINE COMMUNITY COLLEGE

Seattle, Washington 98133

Shoreline Community College has a complete two-year Oceanography and Marine Science Technology Program. Teaching and research facilities are located at the main campus site. The College also owns a vessel which is used in collecting samples and training students in operations.

The degree offered is **Associate of Applied Arts in Oceanography** or an **Associate of Applied Arts in Marine Sciences**. All courses are offered in the science division.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman, Science Division
Shoreline Community College
16101 Greenwood Avenue North
Seattle, WA 98133
(206) 546-4576

SONOMA STATE UNIVERSITY

Rohnert Park, California 94928

Sonoma State University is well situated for the study of marine sciences. It is located in southern Sonoma County within an hour's drive of all parts of the Point Reyes National Seashore, Golden Gate National Recreation Area, Northern San Francisco Bay, Tomales Bay, and the Sonoma Coast State Beaches which extend from Bodega Bay — where the University of California has its marine laboratory — to the Russian River — where the Bohemian Club comes to play.

The University offers a distinctive education in the liberal arts and sciences. With approximately 6,000 students, it is one of the 19 campuses of the California State University. The emphasis is on quality undergraduate education. Master's degrees are offered in selected areas of study.

DEPARTMENT OF BIOLOGY: This department is especially strong in Marine Biology. Among the 14 department faculty are an ichthyologist, two invertebrate zoologists and two phycologists. The department is well equipped and closely supported by the Departments of Chemistry, Physics, Geology and Environmental Studies and Planning. The department owns a variety of instruments as well as marine aquaria, light microscopes, an electron microscope and a 22-foot Boston Whaler for dredging and sampling in the nearby bays and coastal waters.

The following degrees are offered:

1. **Bachelor of Arts in Biology** with emphasis on Marine Biology. The student must fulfill a general education requirement to ensure breadth in other academic disciplines. He may then choose from a number of courses in biology, mathematics, physics, chemistry and geology to ensure breadth in biology and the other natural sciences, and to meet the general requirements for the Biology major. He may then elect to take courses in marine ecology, phycology, invertebrate natural history, functional morphology of the marine invertebrates, mycology, bacteriology, and ichthyology which support the marine biology option within the major (see catalog for details and write to the department chair for a copy of the Marine Biology Advisory Plan).

2. **Master of Arts in Biology - Thesis Option.** The student must complete 30 units of approved graduate studies, take an assessment examination, write a thesis, present it orally, pass an oral exam on the general principles of biology and demonstrate proficiency in a foreign language.

3. **Master of Arts in Biology - Examination Option.** The student must complete 30 units of approved graduate studies, take an assessment examination, demonstrate proficiency in a foreign language, pass an essay and an objective examination.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Biology Department Chair

Sonoma State University

Rohnert Park, CA 94928

(707) 664-2189

SCHOOL OF ENVIRONMENTAL STUDIES AND PLANNING: The school offers a program designed to integrate the biological and physical sciences, the social sciences, and the humanities as they relate to environmental problems.

A *Bachelor of Arts in Environmental Studies and Planning* is offered. The student must fulfill a general education requirement to ensure breadth in other academic disciplines. He may then choose from a number of options within the major. The major options are: Environment Education, Natural Resources and Parks, Water Quality, Energy, Health and the Environment, and City and Regional Planning. The student must also design his own individual plan to support an interest in marine environmental problems. He must also complete a senior project or internship.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Provost, Environmental Studies & Planning

Sonoma State University

Rohnert Park, CA 94928

(707) 664-2306

DEPARTMENT OF GEOGRAPHY: A small department with close student-faculty relationships, geography provides a course of study that is well rounded yet flexible enough to fit specific educational goals. Students can pursue climatology, meteorology or oceanography within the major.

To earn a *Bachelor of Arts in Geography* the student must fulfill a general education requirement to ensure breadth in other academic disciplines, a core requirement for basic grounding in geography, and choose from a number of options those courses in geography and other subjects that best meet the needs of the student interested in marine studies. These include courses in remote sensing, meteorology, geomorphology, climatology, soils, ecology, oceanography, biogeography, geological oceanography, field mapping, environmental geology and hydrology.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Geography Department Chair

Sonoma State University

Rohnert Park, CA 94928

Phone: (707) 664-2194

SOUTHEASTERN MASSACHUSETTS UNIVERSITY

North Dartmouth, Massachusetts 02747

The proximity of the University to the marine environment has resulted in a special emphasis in both faculty research and course orientation toward the estuaries and near-shore waters of the Buzzards Bay region of the Massachusetts coast. The University is also within a one-hour drive of the important libraries, museums, and research institutions of the Boston and Woods Hole area.

The University supports several teaching and research laboratories which are completely equipped for most standard physiological and ecological analyses including gas chromatography, automated CHN analyses, scanning and transmission electron microscopy, liquid scintillation radiometry and computer analyses. Several constant temperature rooms, a greenhouse and a 63-foot oceanographic research vessel, *Corsair*, supplement the general laboratories. The Department also maintains active museum and herbarium collections of the fish, invertebrates, diatoms and seaweeds of the southeastern Massachusetts region.

In addition, the department is in the final planning stages of building a coastal marine laboratory within 15 miles of the North Dartmouth campus. A summer program in marine biology is being considered for the near future.

The following degrees are offered by the Biology Department at Southeastern Massachusetts University:

1. **B.S. in Biology** with option for a degree in higher General Biology or Marine Biology and Coastal Zone Ecology.
2. **M.S. in Biology.**
3. **M.S. in Marine Biology.**

The Department of Biology offers programs leading to the Master of Science degree in either Biology or Marine Biology under either a thesis or non-thesis program of study. Individualized programs of study reflect the research interests of the faculty. Students interested in a research career or continued graduate education may elect a program culminating in a laboratory/field research thesis. Secondary educators interested in broadening their background in biology may elect a program of study culminating in a library research paper.

The Department of Biology offers two options in its program which reflect the general research interests of its faculty: (1) a marine biology option culminating in a Master of Science with specialization in Marine Biology, and (2) a general biology option leading to a Master of Science with emphasis in one of the traditional areas of General Biology. Both options emphasize the development of fundamentals of biology by means of lectures, laboratories, field trips and seminars, and each encourages student engagement in original research leading to the Master's Thesis.

With option (1), the student must successfully complete 30 hours of prescribed coursework as well as successfully defend his/her thesis. Option (2) requires a total of 35 hours of prescribed coursework plus passage of a comprehensive examination. The comprehensive examination may be written and/or oral at the discretion of the examining committee. The student shall demonstrate a satisfactory knowledge of General Biology and three of the following: Botany, Genetics, Microbiology, Physiology, Ecology, Zoology, or Statistics.

Each graduate student plans his course of study with the assistance of an advisory committee. Graduate students will be urged to complete most of their course requirements during their first year. After completion of nine credits, a student will apply by petitioning his advisory committee, for degree candidacy. Degree candidacy will be granted on the recommendation of this advisory committee.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman, Department of Biology
Southeastern Massachusetts University
North Dartmouth, MA 02747

or,

Dean of Faculty
Southeastern Massachusetts University
North Dartmouth, MA 02747

SOUTHERN MAINE VOCATIONAL TECHNICAL INSTITUTE

South Portland, Maine 04106

Southern Maine Vocational Technical Institute is a public, two-year co-educational institute at the post-secondary level, offering technical curricula in a broad variety of fields.

The Marine Science Department is located on the South Portland campus, overlooking Casco Bay. Physical facilities include general classrooms and separate laboratory spaces for navigation, engineering, seamanship, chemistry, marine biology, and oceanography. The department maintains and operates a 146-foot training ship, *Aqualab III*, a 40-foot fishing boat and several small craft.

The Department of Marine Science and Technology offers *Associate Degree* and/or *Diploma* programs in Applied Marine Biology and Oceanography (AMBO) and Marine Sciences (MS).

The Applied Marine Biology and Oceanography program provides a 73 credit hour curriculum which includes oceanographic sciences with emphasis placed on developing a wide range of laboratory and field sampling skills.

The Marine Science program provides a broad background in deck, engineering and oceanographic skills and allows for specialization in one of these areas. The

program includes 70 credits and focuses around the operation and maintenance of the Institute's training ship *Aqualab III*. Students serve as apprentice officers and crew aboard the vessel and gain practical experience in aspects of navigation, seamanship, engineering, and oceanography sampling.

Graduates who have followed the prescribed curriculum and meet physical and sea time requirements are eligible to take the United States Coast Guard license examination for Mate, Uninspected Vessels, Mineral and Oil Vessels, and/or Freight and Towing Vessels, or for Assistant Engineer, Uninspected Vessels and Mineral and Oil Vessels not more than 1000 gross tons. All deck and engine graduates are eligible for endorsement as Ordinary Seaman, Wiper and Stewards Department and with additional sea time as Able Seaman — Special or Oiler.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director of Admissions

Southern Maine Vocational Technical Institute

Fort Road

South Portland, ME 04106

SOUTHWEST MISSOURI STATE UNIVERSITY Springfield, Missouri 65802

The Marine Science program offered at Southwest Missouri State University is provided partly on the local campus, but principally in cooperation with the Gulf Coast Research Laboratory located at Ocean Springs, Mississippi. A number of courses are offered on the Springfield campus and a number of specialized marine courses are provided at the Gulf Coast Research Laboratory. The Springfield facility is equipped with a 250 gallon marine aquarium, various research type equipment for analytical and physiological work and an electron microscope for studying ultrastructure. The Gulf Coast Research Laboratory has nine buildings, most of which have been rebuilt after Hurricane Camille demolished the old ones in August, 1969. In addition, 11 vessels are available from a 64½-foot research vessel, *Gulf Researcher*, down to two 16½-foot Boston Whalers. Research equipment, library facilities, electron microscopes are all available for doing advanced undergraduate and graduate research work.

The B.A. or B.S. degree may be completed with an emphasis in Marine Biology.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Head

Department of Life Sciences

Southwest Missouri State University

Springfield, MO 65802

SOUTHWEST TEXAS STATE UNIVERSITY

San Marcos, Texas 78666

Southwest Texas State University has a cooperative program in Marine Biology with Moody College of Marine Science, Texas A&M University, Galveston, Texas, and The University of Texas Marine Institute, Port Aransas, Texas.

A student completes all of his college work at Southwest Texas State University except nine semester hours of marine biology which is taken at one or both of the aforementioned marine stations. While at Southwest Texas State University, students take three courses in or related to marine biology and are closely associated with students pursuing a major in aquatic biology. Students earn a B.S. with a major in Marine Biology.

This program makes accessible for student use the equipment and facilities at Moody College of Marine Science and The University of Texas Marine Institute. Research equipment at the Aquatic Station, Southwest Texas State University, includes a submarine photometer, seine nets, boats and motors, oxygen analyzers, conductivity meters, pH meters, spectrophotometers, microscopes, photographic equipment, climate control chamber, centrifuges, flow meters, AA spectrophotometer, and nutrient analysis equipment. Aquatic ecosystems include a holding house, raceways, 12 ponds, and a constant temperature river. Different type reservoirs are within a 20-minute drive from the Station. The University library is across the street and housing is available within walking distance from the Station.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Biology Department

Southwest Texas State University

San Marcos, TX 78666

(512) 245-2171

STANFORD UNIVERSITY HOPKINS MARINE STATION

Pacific Grove, California 93950

The station occupies an exposed rocky headland, Mussel Point. The University holds title to about 11 acres on and around that point, which includes approximately one mile of shoreline. The intertidal and offshore waters surrounding the marine station are protected by law as a marine reserve and provide excellent resources for research and teaching in marine biology. The station operates as a branch of the Department of Biological Sciences of the University. The teaching and research facilities at the station are housed in three main buildings. The Agassiz Laboratory provides space and equipment for studies in the biology and ecology of marine invertebrates, fishes and

algae. Special facilities include rooms equipped for microtechnique and photomicrography, a large aquarium room, a reference collection of marine invertebrates and the Gilbert M. Smith herbarium of marine algae. The two-story Jacques Loeb Laboratory provides rooms and other facilities for experimental studies on the development, physiology and biochemistry of marine animals, plants and microorganisms. Cold rooms, constant temperature rooms and a photographic darkroom are available. The laboratories are equipped with a wide variety of specialized equipment including a mass spectrometer, gas chromatography, recording spectrophotometers, radiation counting equipment, high-speed refrigerated centrifuges, a preparative ultracentrifuge, neurophysiological equipment and facilities for electrophoresis and chromatography.

The Lawrence Blinks Laboratory houses two large laboratories, nine smaller research rooms, and five dark laboratories, some equipped for experimental temperature and light regimes. All laboratories are equipped with running seawater.

The Monterey Boatworks is an historic building that for years was the site of a thriving boatworks operation. In 1977 it was entirely rebuilt and now houses the Walter K. Fisher Lecture Hall, the C.B. van Niel Library and a suite of lockers and showers for scuba divers. The library contains a constantly expanding collection of books in the fields most under study (algology, invertebrate zoology, development, ecology, physiology, biochemistry, microbiology, and biological oceanography). About 450 serial publications in these fields are received. The collection currently consists of some 15,000 volumes.

Students can work toward the *Ph.D.* or *M.S. degrees*, with specialization in algology, invertebrate zoology, cellular and developmental biology, immunology, neurobiology, comparative physiology, behavior, population biology, and ecology.

In addition, the Station provides courses in marine biology designed for matriculated and non-matriculated undergraduates and graduates in biology during each quarter.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director
Hopkins Marine Station
Stanford University
Pacific Grove, CA 93950

STATE UNIVERSITY OF NEW YORK AGRICULTURAL AND TECHNICAL COLLEGE

Farmingdale, New York 11735

The two-year Biological Technology curriculum at State University of New York, at Farmingdale, offers a second year specialization in the training of tech-

nicians in the marine-environmental field. The degree earned is the *Associate in Applied Science (A.A.S.) in Biological Technology*.

The teaching facilities consist of seven well-equipped laboratories — one specifically containing modern equipment to teach marine science, as well as the latest environmental testing techniques. Additional facilities include a large walk-in cold room, and a modified van which serves as a mobile environmental laboratory, together with a boat for on-site estuarine studies. The College has access to several larger vessels from neighboring institutions (Maritime, Stonybrook, etc.) for instruction and work in deeper offshore areas.

Requirements for graduation are the successful completion of 65 credits, including nine in Social Science, six in English, six in Mathematics, and 12 in Chemistry.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Department of Biological Sciences

State University of New York

Agricultural and Technical College

Farmingdale, NY 11735

STATE UNIVERSITY OF NEW YORK THE MARITIME COLLEGE

Fort Schuyler, Bronx, New York 10465

The Maritime College is a specialized College of the State University of New York located at historic Fort Schuyler on the Throgs Neck peninsula in the Bronx at the junction of the East River and Long Island Sound. Programs related to the merchant marine and the marine industry are offered. Excellent laboratory facilities for the undergraduate program are on campus. The College also operates the 533-foot, 17,630-ton *Training Ship Empire State*.

Degrees offered:

1. Bachelor of Science:

- a) In Marine Transportation
- b) In Meteorology and Oceanography
- c) In Computer Science-Mathematics

2. Bachelor of Engineering:

- a) In Electrical Engineering
- b) In Marine Engineering
- c) In Naval Architecture
- d) In Ocean Engineering
- e) In Nuclear Science and Engineering

3. Master of Science in (Marine) Transportation Management

The Maritime College is organized as an academy where men and women cadets prepare for licensure as officers for the Merchant Marine while they earn

bachelor's degrees in business, engineering, or science. SUNY Maritime College is the only maritime academy in the United States to offer multiple engineering degree programs that are ABET accredited, and Professional Engineer (PE) license registered. The professional license as either a deck or engineering officer for the Merchant Marine gives graduates access to the full spectrum of civilian seagoing employment. Graduates of all curriculums are fully prepared for rewarding careers ashore as well as at sea because of their academic preparation. Navy ROTC with its scholarship program is available to cadets seeking active duty as officers in the Navy at graduation. Graduates are eligible for commissions as officers in the Navy and Coast Guard Reserve and the Commissioned Corps of the National Oceanic and Atmospheric Administration (NOAA).

An integral part of all Maritime curricula is the annual Summer Sea Term aboard the college training ship *Empire State*. It is during the training cruises to foreign and domestic ports each summer that cadets obtain the necessary practical experience to be eligible to sit for the Coast Guard-administered license examinations during the senior year. To help offset the added expense of a maritime education, all cadets who are U.S. citizens and qualified for both the Merchant Marine license and for Midshipman status in the Navy Reserve are eligible for a federal incentive payment of \$1200/year paid by the Maritime Administration. The full range of financial aid programs that are based on need are also available.

METEOROLGY AND OCEANOGRAPHY: The Meteorology and Oceanography curriculum is designed for the deck officer who desires an undergraduate degree in physical science. It is particularly well suited to the graduate who plans to "sail on his license" and is interested in how the ocean and the atmosphere affect the operation and safety of ships. The curriculum also provides a thorough traditional academic study of the atmosphere and the ocean which can be used as a base for graduate study.

Students completing the program of studies earn the *Bachelor of Science degree* and the license as Third Mate (Oceans Unlimited). In addition to sailing on their licenses in traditional Merchant Marine (Commercial) operations as a deck officer, graduates are especially well qualified to sail as mate/scientist aboard oceanographic research ships using both their professional training and their acquired scientific knowledge. Many graduates have pursued employment with the National Oceanic and Atmospheric Administration including sailing with the NOAA Commissioned Corps.

MARINE ENGINEERING: Marine Engineering is often referred to as "salty" mechanical engineering. There are two facets to marine engineering: (1) the operation, maintenance, and repair of marine propulsion and power systems and other machinery aboard ship — the primary work of the merchant marine engineering officer — and (2) mechanical engineering applied to the

design of systems and devices which can operate in the marine environment such as energy conversion systems, power plants, cargo systems, life support systems for deep submergence operations, and ship-board machinery. Devices which operate in the marine environment are subject to the special problems imposed by corrosion, electrolysis, motion, pressures, and radically changing environmental conditions. The study of marine engineering places heavy emphasis on the study of transport processes (thermodynamics, fluid dynamics, and heat transfer) as well as solid mechanics (statics, dynamics, and strength of materials).

NAVAL ARCHITECTURE: Naval Architecture is the field of engineering concerned with the design, construction, repair, and operation of ships and structures which operate in the marine environment. It is closely associated with marine engineering because of the relationship of machinery to hull systems. Ships are the largest self-sufficient mobile structures made by man. To design such complex systems requires a broad education in most branches of engineering, math and science.

The study of naval architecture stresses fluid dynamics, mechanics, strength of materials, structures, and ship dynamics. The Naval Architecture design core is complemented by courses in operational marine engineering and the summer sea term experiences operating the training ship in preparation for the license as Third Assistant Engineer. In the senior year the student participates in a comprehensive design sequence involving the production of an original design of a commercial vessel such as a container ship, supertanker, offshore tug/supply vessel or fishing vessel, etc.

OCEAN ENGINEERING: Ocean Engineering is a rapidly developing field responding to the challenges presented as man explores and develops the ocean as a natural resource. It is the ocean engineer who is developing the technology for ocean research, off-shore oil and mineral resource recovery, energy conversion, etc.

The ocean engineering major draws from traditional electrical, mechanical, and civil engineering, and includes the study of the ocean environment. In the senior year design project the student can focus on structural or mechanical or electrical problems, or a combination of technological factors such as would be needed in designing, for instance, an underwater habitat, an offshore structure, or an ocean thermal energy conversion (OTEC) power plant.

MARINE TRANSPORTATION: Marine Transportation is the curriculum most commonly associated with Deck Officer license preparation as it addresses the commercial operations of ships and the management and economics of the transportation industry.

Studies in the humanities and sciences are combined with nautical and marine transportation subjects to

achieve a well-rounded collegiate program which will equip the graduate to meet the present and future needs of life and of the maritime industry, afloat and ashore.

The deck license candidate pursuing Marine Transportation can concentrate in either Transportation Economics or Transportation Management. Approximately eight percent of the coursework is common to both concentrations. Those who pursue Transportation Economics concentrate on the broader concepts of economic theory and examination of the forces which affect international trade, commerce, and business organization. Cadets who follow the Transportation Management concentration direct their studies to the principles and practices of transportation industry organization, management, and operations.

NUCLEAR SCIENCE AND ENGINEERING: The Nuclear Science and Engineering major is designed to meet the needs of engineering students who are particularly interested in the applications of nuclear energy. This engineering major leads to the engineering officer license and the *Bachelor of Engineering degree*. Following the two-year core common to all engineering programs, the sequence of courses in the field of nuclear science and engineering includes nuclear reactor theory, metallurgy, radiation science, and nuclear reactor design. The courses dealing with engineering operation include steam generators, electrical systems, and propulsion systems. The complete set of courses is designed to establish a firm foundation for a professional career in the conversion of energy, both fossil and nuclear.

ELECTRICAL ENGINEERING: The *Bachelor of Engineering degree in Electrical Engineering* is available to cadets preparing for either the deck or engine officer license. While the academic core for both electrical engineering degree programs is essentially the same, the license preparation is quite different. Deck license candidates augment their electrical engineering studies with the study of navigation, nautical science, and communications, while the engine license candidates augment their electrical engineering studies with the study of thermal energy conversion devices such as diesel, gas turbine, and steam turbine power plants, and electrical power systems and electronic controls.

COMPUTER SCIENCE-MATHEMATICS: The Computer Science-Mathematics major is available to cadets preparing for either the deck or engine officer license and leads to the Bachelor of Science degree.

The course of study includes the practical and theoretical nautical training required for such officers, together with a series of courses which includes a comprehensive study of computer hardware and software, and programming applications in both scientific and business areas. Programming languages such as a Fortran, Basic, and COBOL, and assembly language, are studied in detail. Numerical analysis, simulation methods, and information processing courses are in-

cluded. In the mathematics area there are calculus, differential equations, finite mathematics, linear algebra, probability, statistics, and other courses. Various electives in both computer science and mathematics are available.

TRANSPORTATION MANAGEMENT (MS) PROGRAM: A *Master of Science degree program in Transportation Management* is offered by the Maritime College and is particularly useful to graduates of other curriculums and colleges who enter the transportation facet of the marine industry. It also provides opportunities for additional studies in transportation management to graduates of the undergraduate program.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director of Admissions

State University of New York

Maritime College

Fort Schuyler, Bronx, NY 10465

(212) 892-3000

STATE UNIVERSITY OF NEW YORK COLLEGE OF ARTS AND SCIENCE Oswego, New York 13126

The State University College at Oswego is located on the shores of Lake Ontario. A number of laboratories are used for oceanographic and limnologic research and teaching. Some of the equipment available includes: atomic absorption spectrophotometer, gas-liquid chromatography, salinity-conductivity meter, dissolved oxygen meters, photometer, mapping equipment, sieve and rapid sediment analysis equipment, bathythermograph, semi-dip-gill and trap nets, specific ion probe, microscopes, spectrophotometers, and various grabs and coring devices.

Some of the equipment and facilities are provided by the State University Research Center at Oswego (SURCO) and Rice Creek Biological Field Station. Two Boston Whalers and several smaller boats are available for research in Lake Ontario near shore waters and lagoons.

A field course is offered in January at the Discovery Bay Laboratory of the University of West Indies in Jamaica. This is primarily a biology course dealing with the ecology of the coral reef and near shore tropical environments.

A Marine Sciences Minor is offered by completing 19 hours in approved courses plus six hours of mathematics, eight hours of chemistry, and eight hours of physics. It is expected that most students will major in Biology, Chemistry, Geology, Meteorology, or Zoology.

The following degrees are offered:

1. **B.A. in Biology.** 30 hours in biology; 24 hours in chemistry, mathematics and physics. Degrees granted in 1982: 55.

2. **B.A. in Chemistry.** 32 to 33 hours in chemistry; 20 hours in mathematics and physics. Degrees granted in 1982: 4.

3. **B.S. in Chemistry.** 44 hours in chemistry; 29 hours in mathematics, physics and foreign language. Degrees granted in 1982: 24.

4. **B.A. in Geology.** 33 hours in geology; 32 hours in chemistry, mathematics and physics. Degrees granted in 1982: 8.

5. **B.A. in Meteorology.** 24 hours in meteorology, 9 hours in earth science, 31 hours in chemistry, mathematics and physics. Degrees granted in 1982: 2.

6. **B.S. in Meteorology.** 27 hours in meteorology, 9 hours in earth science, 31 hours in chemistry, mathematics and physics. Degrees granted in 1982: 18.

7. **B.A. in Zoology.** 31 hours in zoology; 29-30 hours in chemistry, mathematics and physics. Degrees granted in 1982: 30.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Department of Earth Sciences

State University of New York

Oswego, NY 13126

(315) 341-3065

STATE UNIVERSITY OF NEW YORK AT STONY BROOK

Long Island, New York 11794

The Marine Sciences Research Center (MSRC) is the center for research, graduate education, and public service in the marine sciences for the State University of New York system. It offers the only SUNY graduate degree programs in oceanography and marine environmental sciences. MSRC has programs of research in biological, chemical, geological, and physical oceanography; in coastal zone management, and in fishery management. MSRC scientists have a strong commitment to translate the results of research into forms readily usable for management, and when possible, solution of environmental problems. Emphasis in the research and educational programs is on the coastal ocean, approximately to the seaward edge of the continental shelf.

MSRC is located on the South Campus of the State University of New York at Stony Brook. The Center is ideally situated for studies of a variety of coastal environments including estuaries, lagoons, salt marshes, barrier islands, and continental shelf waters. The proximity of New York City and the burgeoning populations of Long Island and Connecticut make New York coastal waters an excellent laboratory for evaluating conven-

tional methods of pollution abatement and coastal zone management. They also present an exciting and demanding challenge to the most imaginative and innovative scientists and planners to develop more effective ways of accommodating the manifold uses of these valuable natural resources.

Since oceanography depends heavily upon its parent sciences, and since an undergraduate degree does not qualify the holder at a professional level, graduate students in oceanography, while concentrating on the special problems posed for scientists who work at sea, must, in addition, progress to professional competence within physics, chemistry, biology, geology, or engineering. This means close association with the practitioners of those disciplines; the kind made possible by the presence of strong graduate programs in those fields. A graduate program in oceanography of superior excellence is difficult, if not impossible, to maintain in the absence of equally strong graduate programs in the basic parent sciences.

At Stony Brook students at the Marine Sciences Research Center are fortunate. Strong programs in physics, chemistry, biology, and geology as well as in pure mathematics, applied mathematics, and engineering exist on campus. Not only do they exist, but they are open to oceanographers who want to increase their professional competence. Opportunities for learning and for collaborative research in these disciplines are unlimited.

The main laboratories and offices of the Marine Sciences Research Center (MSRC) are housed in a cluster of buildings with more than 4,500 square meters of usable floor space. Laboratories are well-equipped for most analyses, and students and faculty have access, with special arrangements, to equipment and facilities elsewhere on the main campus and at nearby Brookhaven National Laboratory and Cold Spring Harbor Laboratory. Center and University Computing facilities are excellent. The University Library has extensive holdings in oceanography and environmental sciences as well as in the basic sciences.

MSRC owns and manages Flax Pond jointly with the New York State Department of Environmental Conservation. An 0.6 square kilometer salt marsh located approximately seven kilometers from campus, Flax Pond is surrounded by large estates and has retained a relatively pristine character. Approximately three-fourths of the marsh has been set aside for research and education, and competing activities are prohibited. The MSRC maintains a well-equipped laboratory with a continuous seawater system at the Pond. The Center operates an 18-meter research vessel, the *R/V Onrust*, which was completed in late 1974. The *R/V Onrust*, designed specifically for oceanographic research, is one of the finest vessels of her kind. She is outfitted for virtually every kind of oceanographic sampling. MSRC also maintains a number of smaller boats.

The following degrees are offered:

1. **M.S. in Marine Environmental Sciences.** The program has the traditional tracks in biological, chemical, geological, and physical oceanography, and a special

track designed to prepare students for careers in environmental management. The emphasis is on coastal and shelf processes. Formal instruction consists of a thoroughly interdisciplinary, problem-oriented curriculum. Students also must take courses selected from other departments on campus.

Requirements for a degree include successful completion with a "B" average of an approved course of study totaling 30 credits, of which not more than six may be seminar and/or research. Students are required to take a core curriculum and to write a thesis of publishable quality.

In addition to full-time admission, the program offers part-time training to professionals who wish to improve or broaden their skills, or redirect their careers. Required courses are alternated yearly between the day and evening schools, and are arranged so that during any given year, half of the required core courses are given in the evening.

The Department of Earth and Space Sciences and the Marine Sciences Research Center jointly sponsor a special five-year *B.S./M.S. program* for outstanding students who wish to pursue a specialty in geological oceanography. The Center has a similar five-year program with the College of Engineering and Applied Sciences for outstanding Engineering Science majors who wish to pursue a specialty in ocean engineering and coastal oceanography.

2. Ph.D. in Coastal Oceanography. The doctoral program in coastal oceanography is a new program designed to give students professional command of oceanography at the highest level and to provide them with the means to develop their capacity for creative research. It prepares students to formulate and attack coastal oceanographic problems — biological, chemical, geological, and physical — practically and theoretically. It builds on a flexible, interdisciplinary program and offers students the opportunity to extend their command of the tools of scholarship and to mature their judgement so that they may become independent, effective solvers of problems.

Every student is required to complete successfully or to demonstrate proficiency in, core courses in biological, chemical, geological, and physical oceanography. Advanced courses offered by the MSRC are required as are courses in related disciplines offered by other departments on campus.

Normally the master's degree, which requires the preparation of an essay of publishable quality, is required of all candidates for the doctor's degree. A doctoral dissertation is required of all candidates. It must demonstrate the ability to formulate an important original problem and to deal with it effectively to increase the student's understanding of oceanography and enrich the scientists whose peer he or she aspires to be.

The entire program is flexible and well suited to the mature student whose professional goals are clearly formulated. It also provides, in its earlier stages, for

extensive exploration of opportunities in the field. Students are free to emphasize their own interests, whether they be in the biological, chemical, geological, physical, or management aspects of the coastal ocean, but they will also acquire a broad understanding of the processes that characterize the coastal ocean. Productive work in coastal oceanography requires a general understanding of the disciplines and a profound knowledge of at least one basic science.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director

Marine Sciences Research Center

State University of New York

Stony Brook, NY 11794

(516) 246-7710

STATE UNIVERSITY OF NEW YORK COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY

Syracuse, New York 13210

The College operates a multiple campus system with regional campuses and field stations located at Syracuse, Tully, Wanakena, Warrensburg, Cranberry Lake, Newcomb and Clayton. This system is composed of about one million square feet of facilities in 179 buildings and 25,000 acres of land.

The main campus is in Syracuse, and lies on 12 acres adjacent to Syracuse University, in an area that traditionally has been known as "The Hill." Specialized facilities at the Syracuse campus include electron microscopes, plant growth chambers, air-conditioned greenhouses, an animal environmental simulating chamber, a bio-acoustical laboratory, a 1000-curie cobalt-60 radiation source, radioisotope laboratory, computer center, and specialized instrumentation including nuclear magnetic resonance spectrometer, electron spin resonance spectrometer, mass spectrometer, ultracentrifuge, x-ray and infrared spectrophotometer. Photogrammatic and geodetic facilities of the forest engineering department include one of the most extensive arrays of equipment in the United States, with a Nistri TA-3 stereocomparator, Mann comparator, computerized Nistri photocartography, and nine other varieties of plotters. Extensive collection are available for study, including wood samples from all over the world, botanical materials, insects, birds, mammals and fishes.

The Cranberry Lake Campus, accessible only by water, is the site of the College's biological station, where, every year, a cooperative program in environmental biology is sponsored jointly by the College and other institutions of higher education. Bounded by 150,000 acres of forest preserve, by Cranberry Lake, and by isolated forest bogs and beaver meadows, the

extensive facilities are intensely utilized in a comprehensive curriculum of upper-level and graduate courses.

The Ellis International Laboratory, a magnificent island, is situated in the heart of the Thousand Islands-St. Lawrence River area off the village of Clayton. Accessible only by water, this laboratory, which is the College's most recent property acquisition, is an unusually appropriate site for the College-wide, cooperative and international environmental monitoring and research activities.

The College maintains a fleet of approximately 60 canoes and 25 registered outboard motor boats ranging from 3-90 hp., located at various campus sites.

The Graduate Program in Environmental Science is a trans-disciplinary graduate program devoted to environmental science in most of its major fields of specialization. Programs are mounted in freshwater ecology, hydraulics, stream regimes, meteorological and climatic impacts on water systems, limnology, wetland ecology, as examples.

Student programs are devised by a faculty committee consisting of experts in the various fields of emphasis desired by the students. Students may enter the program from backgrounds in Law, Political Science, Marine and Environmental Chemistry, the various sciences, or the humanities. An integral part of the program is intensive research on issues confronting government and industry.

The College maintains the Ellis International Laboratory on a College-owned island in the Middle of the Thousand Island region of the St. Lawrence River. This campus is devoted to research and education relating to the Great Lakes system. Equipment adequate for most studies is available — including boats, sampling devices, and laboratory analytical tools.

Both the *Master of Science and Doctor of Philosophy degrees* are offered in this program.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director, Graduate Program in

Environmental Science

SUNY College of Environmental Science and Forestry
Syracuse, NY 13210

STEPHENS COLLEGE

Columbia, Missouri 65215

Stephens College, a private college for women, offers marine sciences courses at its temporary marine station at Key Largo, Florida, during each summer session. Supporting coursework is offered on the main campus at Columbia, Missouri. Boats and facilities, including both dormitory and laboratory space, are rented at Key Largo for the program. Faculty, with

laboratory equipment and a library, are moved from the main campus to Key Largo to conduct the program. The program is designed for the female undergraduate student who wishes a biological science program with an emphasis in marine biology.

The following degrees are offered:

1. **Associate in Arts** degree concentrating in Biology with an emphasis in marine biology (two-year program).

2. **Bachelor of Arts** degree majoring in biology with an emphasis in marine biology (four-year program).

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director, Marine Sciences

Department of Natural Science

Stephens College

Columbia, MO 65201

(314) 442-2211 x475

STEVENS INSTITUTE OF TECHNOLOGY

Hoboken, New Jersey 07030

The Davidson Laboratory is the center for research in ocean engineering at Stevens. The major facilities include: a 320-foot towing tank suitable for model studies of ships and other structures in regular or irregular seas; a 75-foot square basin for model tests on course stability and maneuvering characteristics of ships and submersibles; a 130-foot towing tank for yacht testing; and an enclosed wind tunnel with 2.5 x 3.5 x 12-foot test section and a maximum wind speed capability of 200 feet/second. Stevens has recently joined the New Jersey Marine Sciences Consortium. The facilities and resources of the Consortium will be available to faculty and students in the Ocean Engineering Department for both research and instruction. A 26-foot catamaran is also available for field work in the adjacent rivers and bays.

The following degrees are offered:

1. **Doctor of Philosophy.** The program leading to the Doctor of Philosophy degree is designed to develop a student's capability to perform basic research or high-level design in ocean engineering.

All students entering the doctoral program must have a Master's degree or equivalent. Students who have not earned their Master's degree in the Department of Ocean Engineering must take all of the required courses of the Master of Engineering (Ocean) degree, except if they have taken comparable courses in other institutions.

In addition to having completed courses equivalent to a Master's degree, all doctoral students must pass an oral qualifying examination to test the student's capability for advanced study. The doctoral candidate will be expected to participate in the department's advanced seminar course. The balance of the candidate's

coursework should be composed of advanced ocean engineering courses and electives in other engineering departments as prescribed in his study plan. Upon completion of formal coursework and before starting dissertation research, the doctoral candidate must pass the written preliminary examination.

2. Master of Engineering (Ocean). A program of study leading to a Master's degree should contain at least eight courses in ocean engineering. Four courses, which are core courses for this program, are considered basic to all areas within this field of study. The remaining credits required for the Master's degree can be obtained by either taking all coursework or by additional work including a Master's thesis.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Department of Ocean Engineering

Stevens Institute of Technology

Castle Point Station

Hoboken, NJ 07030

(201) 792-2700 x571

STOCKTON STATE COLLEGE

Pomona, New Jersey 08240

Stockton State College is one of a few undergraduate institutions which offers a degree program in Marine Science. Stockton's Marine Science Program encompasses three major areas of study: Marine Biology, Marine Geology, and Oceanography. A variety of field courses, laboratory courses, seminars, independent studies and tutorials are offered with a strong emphasis on teaching in the field. The program is highly interdisciplinary and requires student competence in more than one area of science. Upper level students have the opportunity to design and implement their own independent study projects on local marine organisms and/or chemical or physical processes. One of the major objectives of Stockton's Marine Science Program is to demonstrate that students, as undergraduates, can become actively involved in research and make contributions to the field.

The minimum requirement for the *Bachelor of Science degree in Marine Science* is 80 credits of Marine Science and cognate courses. These program credits are applied toward the minimum of 128 semester credits necessary for a Stockton degree. The cognate programs to Marine Science include: Biology, Chemistry, Geology, Mathematics, Applied Physics, Environmental Studies and Information and Systems Sciences. Each student in a given track must successfully complete each of the courses listed as required for that track.

Stockton has a small marine station located on Brigantine Island, a fleet of small boats and various kinds of sampling gear for field courses and research

activity. Students have access to the College Computer Center which is tied into the statewide Educational Computer Network.

Courses offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Program Coordinator

Marine Science Program

Stockton State College

Pomona, NJ 08240

(609) 652-1776 x546

SUFFOLK COUNTY COMMUNITY COLLEGE

Riverhead, New York

The fundamental goal of the Marine Technology Program at Suffolk County Community College is to provide high school graduates with two years coordinated technical and general courses at the college level that will enable them to function as technicians in marine and allied industries. Also, students may transfer to a 4-year college for a Bachelor's degree. Studies are carried on in Marine Ecology, Oceanography, Mariculture and Marine Pollution. The Marine Science and Technology Center at Cedar Beach, Southold, New York, contains two laboratories, classrooms, offices and mariculture facilities on a 50-acre site of marshland and beachfront. A 24-foot cruiser and several small boats are available for research purposes.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director, Marine Technology Program

Suffolk County Community College

Eastern Campus

Speonk Riverhead Road

Riverhead, NY 11901

(516) 369-2600

SUFFOLK UNIVERSITY

Boston, Massachusetts 02114

A program in Marine Sciences is offered through the Department of Biology of Suffolk University. The distinguishing feature of the program is the completion of five field courses in marine science, with two of the courses in non-biology disciplines (e.g., geology, chemistry, physical oceanography). The principal identity is that gained by field-course experiences comparable to that taught each summer at the Robert S. Friedman Cobscook Bay Laboratory. The three biology field courses may be used in partial fulfillment of the 30 semester hours requirement in Biology. All College requirements for the A.B. or B.S. degrees apply.

The Robert S. Friedman Cobscook Bay Laboratory is a forty acre field station on the shores of Cobscook Bay in Edmunds, Maine. The station exists as a camping field station which features wooden tents that serve as sleeping facilities, a central multi-purpose building, laboratory facilities, a classroom, circulating sea water system and several water craft. The facility provides a base for field and course work in the biology department and the marine science program.

The Laboratory has the advantage of being in the lower Bay of Fundy region in the northernmost coastal region of Maine. The Bay has the greatest fluctuation of tide anywhere in the continental United States and allows for ready access to the collecting of many marine organisms.

Through the affiliation of Suffolk University with the Ocean Research and Education Society, Inc., the department offers an interterm program on the *R/V Regina Maris*. The *R/V Regina Maris* is a tall ship which takes students enrolled in a special marine course to the Caribbean during the break between Fall and Spring semesters. This trip is combined with a course, seminar, and research project to give the student an on-hands experience with ocean life and ship work. Other opportunities are available on this research vessel from time to time.

The University also is a member of the Massachusetts Bay Marine Studies Consortium, Inc., and the Massachusetts Marine Educators, Inc. These affiliations provide the department with additional educational experiences for the biology student.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director of Admissions

Suffolk University

8 Ashburton Place

Boston, MA 02108

(617) 723-4700

TALLADEGA COLLEGE

Talladega, Alabama 35160

Talladega College Marine Sciences Program employs the teaching and research facilities of the Marine Environmental Sciences Consortium (MESC).

The principal facilities are at the Dauphin Island Research Laboratories on Dauphin Island in Mobile Bay. The Dauphin Island Sea Lab is located on a 36-acre portion of a former U.S. Air Force radar base with seven permanent and five temporary buildings. The Marine Science Hall contains over 5,000 square feet of instructional labs and classrooms, over 2,000 square feet of research space and 850 square feet of office space. A scientific collection of over 1,000 species is within easy access of laboratories and classrooms.

Instrumentation available includes gas chromatography, atomic absorption spectrophotometer, balances, thin-layer chromatography, calculators, and the usual complement of laboratory materials. Field gear includes current meters, oxygen meter, plankton nets, corers, data buoys, transmissometers, water quality monitors, a variety of trawls and other nets for collecting, bottom grabs, photometer, refractometer, pH meter and a variety of water samplers. The Sea Lab can accommodate 250 persons in residence; support facilities include an apartment building, two dormitories, cafeteria, 13 three-bedroom family houses, and maintenance shops. Research vessels available for class and research activities include: *R/V G.A. Rounsefell*, 65-foot, diesel powered; *R/V Flying Tiger*, 40-foot fiberglass, twin diesel powered; a 33-foot wood, diesel powered shallow water vessel; three outboards (14-foot to 23-foot).

No degrees in marine sciences are offered; however, a student may earn a certificate of attainment after completing two summers of marine science courses. The certificate will accompany a degree in a traditional major in one of the academic disciplines at Talladega College.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman, Biology Department and

Division of Natural Sciences and Mathematics

Talladega College

Talladega, AL 35160

TARLETON STATE UNIVERSITY

Stephenville, Texas 76402

Tarleton State University offers a *B.S. degree in Biological Science* with emphasis in Marine Biology. The marine program is offered in cooperation with Texas A&M University at Galveston, Texas. All basic coursework is taken on the Tarleton campus with summer courses available from A&M's Galveston laboratory.

In addition to general university requirements for graduation, students take courses in general biology, microbiology, heredity, invertebrate zoology, ecology, oceanography, introduction to marine biology, marine ecology, physical geology, biostatistics, physics, and chemistry through organic. Science electives may be selected from: invertebrate paleontology, sedimentology, ichthyology, population dynamics, limnology, aquatic environment, parasitology, animal or plant physiology, biology of mammals, and systematic zoology. Other electives are available in the Department of Physical Sciences.

Tarleton State University is part of the Texas A&M University System and is located on a 125-acre campus at Stephenville, 65 miles southwest of Fort Worth, Texas. Biological and physical sciences are housed in

a 56,423-square foot science building. Facilities are well equipped for systematic, ecological and physiological studies. Current marine research includes: systematics, ecology, and distribution of brachy-uran crabs of the West Indies; and ecological studies of Caribbean coral reefs.

A M.S.T. is offered in Biological Sciences. Research and non-research programs are offered. Grants, work programs, loans, assistantships and scholarships are available through the student financial aid office.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director of Marine Studies

Department of Biological Sciences

Tarleton State University

Tarleton Station

Stephenville, TX 76402

TEXAS A&M UNIVERSITY

College Station, Texas 77843

Texas A&M University's major marine facilities are located on the main campus at College Station and at the Mitchell Campus and Fort Crockett in Galveston.

The University's Departments of Oceanography and Meteorology are housed in a 15-story building on the main campus. This well-equipped teaching and research complex is complemented by a staging and docking facility at the Mitchell Campus on Pelican Island, Galveston. The Oceanography Department operates *R/V Gyre*, a 170-foot oceangoing ship which is outfitted for deep-sea studies. It carries a crew of 11 and a scientific party of 18 and has a cruising range of 8,000 miles. In 1974, the Department's teaching and research activities were expanded with the delivery of a 20-foot, two-man submersible, *DRV Diaphus*. The vessel can operate at depths of 1,200 feet and can sustain a maximum speed of approximately two knots for one hour, a slower speed for four hours, and can remain stationary for extended periods. A new wing to the Biological Sciences Building provides additional laboratory facilities for biology and wildlife and fisheries sciences. Cooperative programs exist to provide field laboratories for students and faculty. For example, the Department of Fisheries and Wildlife Sciences is working with Houston Lighting and Power Company to study problems associated with new and existing power generating plants.

The Environmental Engineering Division of the Civil Engineering Department carries out a broad teaching and research program with particular emphasis in estuarine water quality. The division operates a field laboratory on Galveston Bay. A well-equipped laboratory on the College Station campus supports the field programs. The division operates two research vessels which dock at the field laboratory. The 72-foot *R/V Excellence II*, and the 48-foot *R/V Quest*.

The division's research program includes analytical water quality models for coastal and estuarine areas, evaluation of pollutant and quality parameter mass balances in coastal aquatic systems, water quality management methods, reaeration, hazardous materials control, advanced waste treatment and water reclamation.

The Hydromechanics Laboratory serving the Ocean Engineering program was established in February, 1969, to study the major Gulf Coast bays and estuaries. The Laboratory has facilities for research and teaching, including large, equipped wave tanks, wave-sediment basins, recirculating flumes and wave/current flumes, and field measurement equipment such as current meters, "wave-rider" buoys and pressure-type wave gauges.

The Center for Dredging Studies was established in June, 1968, in response to renewed interest in greater utilization and exploitation of minerals from the ocean floor and increased dredging activities in estuaries and offshore. A modern dredging laboratory was added in 1970.

Moody College, created in 1971, is the marine and maritime component of The Texas A&M University System and is located on two campuses, Mitchell Campus and Fort Crockett Campus, in Galveston. The College consists of the School of Marine Technology, Texas Maritime Academy, and Coastal Zone Laboratory. The degree programs offered are four-year courses of study with majors in Marine Biology, Marine Engineering, Marine Sciences, Marine Transportation, Maritime Administration and Maritime Systems Engineering. All programs, except Maritime Administration and Maritime Systems Engineering, offer directly, or as an option, training leading toward qualification for a U.S. Coast Guard license as a Third Mate or Third Assistant Engineer.

The Mitchell Campus of Moody College encompasses 100 acres on Pelican Island in Galveston Bay and has seven buildings: a dormitory, student center, classroom/laboratory building, classroom building, engineering building, central services building, and Texas A&M University Department of Oceanography's marine staging and storing facility, as well as wharfage for the 473-foot, 15,000 ton, Texas Maritime Academy training ship *Texas Clipper*.

The Fort Crockett campus consists of a three-story building on one and one-half acres of Galveston Island. The College's primary research laboratory, the laboratory facilities for the upper-level biology courses, the Radar Observer School, the Coastal Zone Laboratory and various support activities occupy this campus.

The College also features a Summer-School-at-Sea program where students can earn six college credits during the months between high school graduation and enrollment as a College Freshman in a regular academic year. The training vessel, *T/S Texas Clipper*, serves as a classroom for the work/study program. The *Clipper*, a converted cargo/passenger liner has an

annual cruise to foreign ports for cadets and summer school freshman participants.

The Maritime Academy, one of six State Maritime Academies in the country, administers the license curriculum for its students. Students are part of a cadet corp and live either aboard the *T/S Texas Clipper* or in the Moody College dormitory. Cadets in the license program may apply for one of the 35 federal subsidies awarded to eligible incoming freshman in the U.S. Maritime Service Corp of Cadets.

The Department of Wildlife and Fisheries Sciences has research and extension programs in marine fisheries at the Corpus Christi Research and Extension Center. This facility has laboratories and offices that house and support faculty and student research in mariculture. Shrimp mariculture and environmental research are equally important activities in the marine orientation of this center. Its proximity to the estuaries, bays, and ports make it an especially attractive site for research in the Lower Gulf Coast region of the state.

The Department of Animal Science has research and extension programs in seafood technology located in the new Kleberg Center on the West Campus. These facilities consist of modern, well-equipped laboratories to perform chemical, microbiological and technological studies of seafoods and seafood products. It also has offices and facilities for the seafood extension specialist and consumer education specialist. A seafood technology laboratory is located at the Texas A&M Agricultural Research and Extension Center in Corpus Christi.

The following degrees are offered:

1. **B.S. in Marine Biology.** This program offers training in the biology of coastal and marine environments. It is structured to provide the student with not only a strong basis of formal academic instruction, but also considerable hands-on field and collection experience by taking advantage of the coastal location of the College. A general core of courses during the freshman and sophomore years provides foundation for specialization during junior and senior years through the liberal program of electives.

High school preparation should include: biology, chemistry, physical sciences and mathematics.

Graduates of this program will be prepared for general marine biology careers or may wish to further their studies at the graduate level. Potential career areas include: marine biology, marine pharmacology, marine medicine, fisheries biology, biological oceanography, aquatic ecology, environmental sciences and various levels of teaching in marine biology.

2. **B.S. in Marine Sciences.** This program takes the generalist approach with a combination of courses in humanities, sciences, and various marine subjects. The program takes advantage of the coastal location of the College to provide the student with extensive hands-on experience in addition to a solid base of formal academic instruction in the science of the coastal, estuarine and marine environments. A general core of courses

during the freshman and sophomore years provides a foundation for specialization during the junior and senior years through a liberal program of electives. This curriculum emphasizes mathematics, life sciences, physical sciences and earth sciences.

High school preparation should include: biology, chemistry, physical sciences, and mathematics.

Graduates of this program will be prepared for general marine science careers or may wish to further their studies at the graduate level. Potential career areas include: marine geology, marine biology, oceanography, marine geography, environmental sciences, and various levels of teaching in marine science.

3. **B.S. in Maritime Systems Engineering.** This program is for the students inclined toward the physical ocean sciences and ocean engineering. The Maritime Systems Engineering curriculum concentrates on the fundamental engineering design in combination with humanities, sciences and various marine subjects. The general core of courses in humanities, sciences and engineering during the freshman and sophomore years provides a foundation for specialization in one of the options (Ocean Engineering, Coastal Structures, or Hydro-Mechanics) during the junior and senior years. The program is designed to train students for work or further study in any marine oriented engineering field. A thorough preparation in mathematics, sciences and basic applied engineering subjects is recommended for students pursuing this degree program.

Graduates are prepared for numerous jobs in the maritime and ocean industries. Job opportunities in this area include design of various coastal and offshore structures, undersea pipelines, mobile drilling vessels, offshore ports, surface effect vehicles, hydrofoil vehicles, etc. Students may also further their studies at the graduate level in areas of physical oceanography, advanced ocean engineering and environmental engineering.

4. **B.S. in Marine Transportation.** This license-oriented academic program consists of eight academic semesters and three summer training cruises. Cruises are 10-weeks in duration and are taken aboard the *T/S Texas Clipper*. This program combines studies in humanities and sciences with instruction and training in maritime disciplines to provide the U.S. Maritime Service cadet with a broad-based education. The student who successfully completes the license program will be qualified to take the U.S. Coast Guard license as a Third Mate, Steam and Motor Vessels, Oceans, Unlimited.

High school preparation should include mathematics, English and chemistry.

5. **B.S. in Marine Engineering.** The Marine Engineering program emphasizes the theory, design, operation and maintenance of maritime power plants and associated equipment. Engineering theory and practice are coordinated by relating classroom study to the students' practical experience aboard the *T/S Texas Clipper*. Thorough preparation in mathematics, sciences

and basic and applied engineering subjects is recommended for students pursuing this degree program. An option leading toward U.S. Coast Guard licensing is available to U.S. Maritime Service Cadets through the Marine Engineering curriculum. The student who successfully completes the license program will be qualified to take the U.S. Coast Guard license examination for Third Assistant Engineer, Steam and Motor Vessels, Unlimited Horsepower.

6. B.S. in Maritime Administration. This curriculum administered by the Department of Marine Transportation, is designed to prepare the graduate for work in the administration of the coastal and maritime industries or government organizations involved in coastal marine and maritime affairs. The curriculum provides a strong foundation in management, finance, marketing, accounting, and economics. This foundation then becomes a basis for courses that specialize in various aspects of marine and maritime industries such as port operations, brokerage and chartering, maritime law and inland waterways.

7. M.S. in Biology, Botany, Microbiology or Zoology (marine emphasis). Students who are candidates for an M.S. degree are required to obtain practical experience in some phase of marine biology and to demonstrate competence by satisfactorily completing a comprehensive examination and a thesis project. Each student is required to satisfactorily complete 32 hours of coursework, eight of which will be credited for successfully completing an acceptable research thesis.

8. Ph.D. in Biology, Botany, Microbiology or Zoology (marine emphasis). Students are required to obtain practical research experience in areas of marine emphasis. Though there are no absolute course requirements, each doctoral candidate is expected to complete at least 96 semester hours above a B.S. (B.A.) or 64 semester hours beyond an M.S. (M.A.). To qualify for the preliminary examination, the student must satisfy the language work, excluding dissertation research credits. The examination is both oral and written unless otherwise recommended and approved. Following completion of the preliminary examination, the student pursues a dissertation problem to demonstrate his capability for independent research.

9. M.E. in Civil Engineering with a program in environmental engineering. The Master of Engineering degree requires a minimum of 36 semester hours of which one third is taken in fields other than the major field. A thesis is not required. With these exceptions, requirements are the same as those for the Master of Science degree.

10. M.S. in Civil Engineering with a program in environmental engineering. The Master of Science degree program requires a minimum of two full semesters of approved courses and research (32 semester hours). This requirement is ordinarily met by completing at least 24 hours of coursework and up to eight hours of research. A thesis embodying original work is required. The student is required to pass a final examination, covering his graduate programs, which is adminis-

tered by the student's graduate committee and may be either written or oral.

11. Ph.D. in Civil Engineering with a program in environmental engineering. The doctoral degree requires a minimum of six full semesters of acceptable advanced study (96 hours of research and formal courses above a bachelor's degree). To qualify for the preliminary examination, the student must have completed all but approximately six hours of the formal coursework on his degree program excluding dissertation research credits. The examination is both oral and written unless otherwise recommended and approved. Following completion of the preliminary examination, the student pursues a dissertation problem to demonstrate his capability for independent research.

12. B.S. in Wildlife and Fisheries Sciences with an option in wildlife ecology, natural history, fisheries ecology, aquaculture, teaching or museum science. Entering freshman enroll in a program of two semesters of basic courses. At the beginning of the sophomore year, the student selects one of seven options. The junior and senior years are oriented toward specialization in the option selected. Emphasis is on programs which are designed to train individuals in the science of wildlife and fishery management and ecology, aquaculture and mariculture; for research in the ecology, systematics, zoogeography and general science, conservation of natural resources, biology, and zoology; and for positions as exhibit specialists, curators and allied work in museums and nature centers.

13. M. Agr. in Fisheries Science or Wildlife Science. In this non-thesis degree, approximately 12 of the 36 required credit hours are taken outside the student's option. Each candidate is required to obtain practical experience in his chosen option by fulfilling an internship and is required to prepare one or more written reports on the internship experience. The reports are expected to be of a scholarly nature and may carry up to four hours of credit.

14. M.S. in Wildlife and Fisheries Science. Students who are candidates for an M.S. degree are required to demonstrate competence by satisfactorily completing a comprehensive examination and a thesis project. Each student is required to satisfactorily complete 32 hours of coursework, eight of which will be credited for successfully completing an acceptable research thesis.

15. Ph.D. in Wildlife and Fisheries Science. Students are required to obtain research experience in the areas of fisheries science or wildlife science emphasis. Though there are no absolute course requirements, each doctoral candidate is expected to complete at least 96 semester hours above a B.S. or (B.A.) or 64 semester hours beyond an M.S. (M.A.) to qualify for the preliminary examination, the student must complete all but approximately six hours of his formal coursework, excluding dissertation research credits. The examination is both oral and written unless otherwise recommended or approved. Following completion of the

preliminary examination, the student pursues a dissertation problem to demonstrate his capability for independent research.

16. M.S. in Food Technology. In addition to Food Technology courses, students in the Department of Animal Science can take Marine Biology or Fishery courses subject to approval of the student's Graduate Committee. The student conducts research on technological problems of handling, preservation and utilization of marine organisms. Each student is required to complete 32 hours of coursework.

17. Ph.D. in Food Technology. Students majoring in Food Technology in the Department of Animal Science may take Marine Biology and Fisheries courses, subject to the approval of the student's Graduate Committee. The student conducts research on technological problems of handling, preservation and utilization of marine organisms.

18. B.S. in Agricultural Economics. The curricula in agricultural economics is designed to train graduates for a wide variety of jobs in agriculturally-oriented business firms and government agencies. Sufficient flexibility is included in the curricula so that a student, in consultation with his faculty advisor, can develop a degree program which best fits personal career objectives.

Options available in agricultural economics are: (1) agribusiness, (2) farm and ranch management, (3) food and fiber marketing, (4) resources economics, and (5) rural development. The course requirements are the same during the freshman and sophomore years for all options. Students may select an option at any time, but must do so prior to registering for their junior year.

19. M.S. in Agriculture Economics. The program of study leading to the degree of Masters of Agriculture in Agricultural Economics is designed to serve those who desire graduate professional training without research orientation. The objective of the degree is to provide graduate studies for students interested in managerial or service careers in agriculture and related businesses. Students electing this option normally do not plan to do graduate work beyond the Masters. A professional internship and a written problems paper are required. The minimum 36 credit hours are from both Agricultural Economics courses and from other departments, depending upon the program of study selected by the student. Considerable flexibility in course requirements is permitted to meet special interests.

20. M.S. in Agricultural Economics. The Degree of Master of Science in Agricultural Economics is designed to provide the student with training in economic theory and application of theory to the agricultural and marine sector of the economy. Training helps students identify the basic nature of problems and conduct and interpret research. There are two Master of Science Options — thesis and non-thesis. Each candidate is expected to demonstrate competency by satisfactorily completing a thesis based on original re-

search if the thesis option is selected and a well-documented research paper if the non-thesis option is selected. An oral examination covering both the research and coursework is required.

21. Ph.D. in Agricultural Economics. The doctoral program in Agricultural Economics is designed to develop competence in advanced economic theory, in techniques of analysis and in the application of both to economic problems in agriculture. These programs have been designed to take advantage of the strengths of the Department of Agricultural Economics and the supporting disciplines of Economics, Statistics, and Wildlife and Fisheries Sciences. A program with different emphasis in the supporting areas is possible with the approval of the Departmental Graduate Advisory Committee. Each candidate is expected to demonstrate competency by satisfactorily completing (1) a comprehensive written examination in each specialty field of study chosen, (2) a dissertation demonstrating original independent scholarly research, and (3) a final oral examination.

22. M.S. in Management with a Marine Resources Management Specialization. The curriculum consists of a minimum of 36 semester hours to a maximum of 51 hours, depending upon business-related courses the student has previously completed. Of this total, a minimum of 24 hours needs to be in management, largely focusing on various aspects of marine resources management, and a minimum of six hours in a supporting field. Students with no prior background in business administration subjects may be required to take up to 27 semester hours of foundation coursework in areas such as accounting, business analysis, economics, finance, management, and marketing.

The M.S. degree also provides the opportunity to complete a thesis (six semester hours) as well as a professional paper (three semester hours). These activities may be substituted for coursework.

23. M.B.A. with a Marine Resources Management Specialization. The basic curriculum consists of a minimum of 36 to a maximum of 60 semester hours, depending upon the business-related courses the student has previously completed. Regardless of background, all students complete the "professional core," which consists of 21 semester hours in the fields of accounting, business analysis, economics, finance, management, and marketing. Fifteen semester hours are normally taken in the marine resources management specialization area. A limited number of elective hours of coursework may also be taken in other areas.

24. M.P.A. with supporting area in Marine Resources Policy and Administration. Through the Department of Political Science, the College of Liberal Arts offers an interdisciplinary, non-thesis program leading to the degree of Master of Public Administration under joint auspices with the College of Business Administration and the cooperation of the College of Engineering. This 36-hour program usually includes an additional six hours of internship, and consists of a general ad-

ministrative core, an analytical core, six hours of electives, and nine-15 hours in a supporting area, one of which is Marine Resources Policy and Administration in the Department of Management. The normal core of activity for this supporting area includes study in Marine Resources Management, Marine and Coastal Zone Law, and Coastal Zone Management, and it occurs in the broader context of other requirements for the M.P.A. degree.

25. B.S. in Ocean Engineering. This degree program is oriented toward the student who desires an engineering degree which will prepare him for designing and constructing structures and other works in the estuaries, along the shore and offshore. The program is structured so that basic and applied engineering is combined with courses in all branches of oceanography to acquaint the student with the ocean environment. A large number of elective courses are available to permit the student a certain degree of specialization. The degree is fully accredited by E.C.P.D.

26. M.S. in Ocean Engineering. Students can specialize in any area of ocean engineering after taking 15 credit hours of required courses in mathematics, hydromechanics, coastal engineering and physical oceanography. The Master of Science degree program requires a minimum of two full semesters of approved courses and research (32 semester hours). This requirement is ordinarily met by completing at least 27 hours of coursework and up to five hours of research. A thesis embodying original work is required. The student is required to pass a final examination which may be written and oral, or oral and is conducted by the student's Advisory Committee.

27. M.E. in Ocean Engineering. Approximately one third of the required 36 credit hours of coursework is taken in fields outside of the major field for the M.E. degree. A thesis is not required, but the work in the major field will include one or two written reports for which up to four hours of credit is permissible. With these exceptions, requirements are the same as those for the Master of Science degree.

28. Ph.D. in Ocean Engineering. The student can specialize in one or more areas of ocean engineering and are guided by the Advisory Committee consisting of not fewer than four members of the Graduate Faculty representative of the student's several fields of study and research. The students with baccalaureate degrees must spend two academic years in resident study on the main campus in College Station. Those who hold a Master's degree must spend one academic year in resident study on the main campus. A minimum of 96 credit hours beyond the baccalaureate degree or 64 credit hours beyond the Master's degree is normally required for the degree of Doctor of Philosophy. A qualifying examination and a preliminary examination (both written and oral) are required. Following successful completion of the preliminary examination, the student pursues a dissertation problem to demonstrate his capability for independent research. The final examination may cover the broad field of the candidate's training, but the major portion of the

time will be devoted to the dissertation and closely allied topics.

29. Ph.D. in Engineering. The Doctor of Engineering Program has as its objective the education of men and women to function at the highest levels of the engineering profession, with emphasis on solving problems which arise in the utilization of technology to benefit mankind. The curriculum includes a 68 semester-hour pre-professional program and 160 semester credit-hour professional program which includes an internship. The professional programs are administered by the departments in the College of Engineering, together with the College of Engineering and the Graduate College.

30. M.S. in Oceanography. A minimum of two full semesters of approved courses and research (32 semester hours) are required for the Master of Science degree. Ordinarily the student devotes the major portion of this time to work in one field or two closely related fields. Other work is in supporting fields of interest. Generally, not less than one-third of the coursework, excluding research, is taken in one or more fields outside the major field.

Specialization may be undertaken by both the M.S. and Ph.D. degrees in biological, chemical, geological, meteorological and physical oceanography. An effort is made to maintain a balance between the biological, chemical, geological, geophysical and physical aspects of oceanography both in teaching and research.

31. Ph.D. in Oceanography. To qualify for the preliminary examination, the student must have satisfied the language requirement and have completed all but approximately six hours of the formal coursework on his degree program, excluding dissertation research credits. The examination is both oral and written unless otherwise recommended or approved. Following completion of the preliminary examination, the student pursues a dissertation problem to demonstrate his capability for independent research.

32. B.S. in Geophysics. Students may obtain a B.S. degree in Geophysics with a marine emphasis by taking various oceanography courses as electives. The program includes strong preparation in geology, mathematics and physics as well as geophysics. Graduates would be qualified to participate in offshore geophysical exploration programs designed to search for minerals.

33. M.S. in Geophysics. Students interested in marine aspects of geophysics would take courses in oceanography and perform research in the marine environment. The M.S. program requires a thesis which would relate to marine aspects of geophysics, such as geophysical exploration at sea, measurement and analysis of marine seismic, magnetic, gravity and bathymetric data and its geological/geophysical interpretation.

34. Ph.D. in Geophysics. Students with interests in marine geophysics may elect to complete a Ph.D. program in this subject area. The program is similar to the M.S. program except that the Ph.D. dissertation

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(U) NAVAL OCEANOGRAPHIC OFFICE NSTL STATION MS 1986

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(U) NAVAL OCEANOGRAPHIC OFFICE NSTL STATION MS 1986

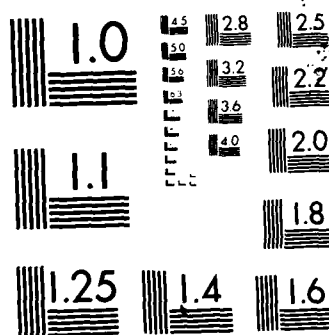
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NATIONAL BUREAU OF STANDARDS 1963-A

research topic would be more substantive than that treated for the M.S.

35. M. Agr. in Recreation and Resources Development with a specialization in marine recreation management/development. A minimum of 40 hours of graduate credit beyond the bachelors is required for the professional degree. Coursework is split between major and supporting fields. Each candidate is required to prepare two professional papers for credit in addition to a six-month internship.

36. M.S. in Recreation and Resources Development with a specialization in marine recreation management/development. This degree requires the satisfactory completion of 32 hours of coursework, eight hours of which will be credited upon completion of an acceptable thesis. The remaining coursework may be split between the Recreation and Parks Department and supporting fields to meet individual coursework needs.

37. Ph.D. in Recreation and Resources Development with a specialization in marine recreation management/development. Each doctoral candidate must complete a minimum of 64 hours beyond the Master's degree. Coursework may be divided between major and two supporting fields by agreement with the student's Graduate Committee. To qualify for the preliminary examination, the student must have completed all but approximately six hours of the formal coursework on his degree program, excluding dissertation research credits. The examination is both oral and written. Following the preliminary examination, the candidate pursues a dissertation problem to demonstrate his research capability.

38. M.A. in Anthropology (nautical archaeology emphasis). Students who are candidates for this degree are expected to gain a general background in the history of seafaring, wooden hull construction, conservation of underwater antiquities, and underwater excavation techniques. Most decide to specialize in Old World or New World shipping. Knowledge of one modern foreign language, 30 hours of coursework, and a thesis are required. Opportunities for field experience exist both from University projects, and from joint projects with the Institute of Nautical Archaeology which is affiliated with Texas A&M University.

39. Master of Urban Planning. The Master of Urban Planning graduate program as accredited by the American Institute of Certified Planners provides for specialization in coastal zone management. This specialization follows completion of the student's 26 hours of required core courses. Coastal zone management is taught as a special application of planning within the context of the state and federal legislation in the field. Approximately 16 hours of additional graduate work and a six credit hour internship are required. The degree program is typically developed in interdisciplinary fashion in close cooperation with geology, oceanography, business management, civil engineering and others. The internship required of all Urban and Re-

gional Planning students in the case of a person with this specialty ordinarily be solved with a regional planning agency in a coastal area or with a state or federal agency administering coastal zone programs.

40. D.E.D. in Regional Science. The Doctor of Environmental Design degree in Urban and Regional Science is an academic degree comparable to a Ph.D. The student has wide latitude in selecting a specific research topic which relates to marine or coastal zone issues. Typically students with this interest come to the department from geography, marine sciences, environmental sciences, and other disciplines concerned with ecological systems in sensitive coastal areas. The student will concentrate on a specific topic; for example, the utilization of sensitive areas for recreation purposes by nearby urban population centers without undue adverse impacts upon biosystems important for agriculture and fishing or energy resources exploration. A total of 96 credit hours beyond the baccalaureate are required or 64 hours beyond a Master's program or equivalent. The student is required to spend two consecutive semesters in residence and may pursue other research efforts related to his dissertation away from the main campus. Acceptable graduate courses taken elsewhere may be transferred into this degree program in accordance with the regulations of the Graduate College.

41. M.S. in Veterinary Microbiology with primary emphasis on diseases of fish and shellfish. The program is available to Doctors of Veterinary Medicine and others with exceptional qualifications. The basic curriculum consists of at least 24 hours of coursework and up to eight hours of research in the areas of bacteriology, virology, mycology or immunology of aquatic animals. A thesis embodying original work is required. The student is required to pass a final oral examination administered by his Graduate Committee.

42. Ph.D. in Veterinary Microbiology with primary emphasis on diseases of fish and shellfish. The program is available to Doctors of Veterinary Medicine and others with exceptional qualifications. The doctoral degree program requires a minimum of six full semesters advanced study (96 hours of research and formal courses above a bachelor's degree). The student will have completed most of his formal coursework prior to the preliminary examination. The examination is both written and oral unless otherwise recommended and approved. Following completion of the preliminary examination, the student pursues a dissertation to demonstrate his capability for independent research.

Curriculum offered: available in school catalog.

Faculty appointments, available in school catalog:

To obtain further information, address inquiries to:

Registrar

Texas A&M University

College Station, TX 77843

TEXAS CHRISTIAN UNIVERSITY

Fort Worth, Texas 76129

Several large laboratories have been designated for marine-oriented research and include four large seawater systems. Facilities are well equipped for systematic ecological, chemical and physiological marine studies. Studies of rivers, estuaries and shallow-water marine habitats are emphasized. The University also has made arrangements for field research on Swan Island in the Caribbean.

M.S. degrees are available in **Biology, Environmental Science and Geology** with emphasis on marine problems.

M.S. in Environmental Science. This program is an interdisciplinary one between the Departments of Biology and Geology. All students must complete four graduate core courses. Nine hours of electives may be chosen from biology, geology or approved by the Environmental Sciences Committee. Three hours of seminar and six hours of thesis must also be completed. Regardless of prior major discipline, the student should have a minimum of one year each of biology and chemistry and one course in physical geology. Students who do not have credit must complete at least one course in calculus and one in metropolitan and regional planning prior to completion of the degree.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Chairman

Department of Biology
Texas Christian University
Fort Worth, TX 76129

UNITED STATES COAST GUARD ACADEMY

New London, Connecticut 06320

The U.S. Coast Guard Academy is the federal service academy for the education and training of Coast Guard Officers. The entire curriculum is designed around the sea and marine maritime affairs. Of particular interest are programs in marine science, marine engineering and ocean engineering.

Marine science courses are offered under the Department of Physical and Ocean Sciences. Special facilities include refrigerated aquariums and a series of culture tanks for marine organisms, estuarine models, a weather satellite photo receiver and a completely equipped fleet of small craft for oceanographic studies of Long Island Sound and adjacent waters. The Dartmouth Time Sharing Computer System is used in most science courses and research projects. Summer programs utilize the large vessels of the Coast Guard for high seas and polar expeditions.

The courses at the Academy lead to a **Bachelor of Science degree**, with designation of the major study area. For marine science, the course offerings are designed to give the student a taste of deep-sea oceanography and biology as well as an appreciation for the coastal environment and its problems. Students who select a marine science area as a study option complete a basic pre-science/engineering background program which consists of five semesters of mathematics, three semesters of physics, three semesters each of nautical science and marine law, two semesters of chemistry and one semester each of mechanics, electrical science and basic naval architecture. In addition there is the program of required oceanography courses.

Ocean Engineering and Marine Engineering programs are offered by the Department of Engineering. Both curricula are accredited by the Engineering Council for Professional Development.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Office of the Director of Admissions

U.S. Coast Guard Academy

New London, CT 06320

UNITED STATES MERCHANT MARINE ACADEMY

Kings Point, New York 11024

The academy's 39 building and marine facilities occupy 65 acres on the north shore of Long Island overlooking Long Island Sound and include academic buildings, resident halls, shops and laboratories. In addition, the academy operates miscellaneous small training craft on Long Island Sound.

The United States Merchant Marine Academy offers a four-year undergraduate program which leads to a Bachelor of Science degree and a Merchant Marine license as a Third Mate or Third Assistant Engineer. In addition, graduates are commissioned as Ensigns in the United States Naval Reserve. The Academy is accredited by the Middle States Association of Colleges and Secondary Schools.

Three major curricula are offered: Nautical Science for the preparation of deck officers, Marine Engineering for students interested in becoming engineering officers, and a combination of the two, a Dual License curriculum, which leads to a license in each specialty. In addition to a major, each midshipman may also take a minor or a concentrate elective program in such specialized fields as oceanography, nuclear engineering, management science, computer science, mathematics, chemistry and naval architecture. General education courses make up about one

third of each of the professional curriculums and all midshipmen are required to take naval science courses prescribed by the Department of the Navy.

The academic year at the Academy is divided into four academic quarters which span 11 months, from the first week of August to the end of June. As an integral part of the academic program, midshipmen spend the first half of their sophomore year and the last half of their junior year at sea.

The curriculum at the Academy is thus stimulating and comprehensive. It is designed to assure that each midshipman, upon graduation, will be professionally competent, trained for leadership and responsibility, and well-rounded intellectually.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director of Admissions

United States Merchant Marine Academy

Kings Point, NY 11024

UNITED STATES NAVAL ACADEMY

Annapolis, Maryland 21402

The location of the Naval Academy, at the mouth of the Severn River on the Chesapeake Bay, is ideal for the conduct of field studies in oceanography, ocean systems engineering and meteorology. An 81-foot, 71-ton research vessel, supported by a pierside laboratory facility, is available for group or individual instruction and research. The vessel is fully instrumented for oceanographic and bathymetric data collection, including among its equipment an automatic precision positioning system, an automatic salinity/temperature/depth/sound velocity sensor-recorder, and a precision hydrographic echo sounder.

Laboratory and computer utilization play a dominant role in the programs. Computer equipment available includes a Honeywell 6060, a PDP 1576-1540 hybrid computer and several PDP 8, 11, and 15's. A wide variety of modern laboratory equipment is provided, including a subcritical nuclear reactor, an oceanographic wave tank, an 85-foot towing tank with wave generating and on-line data acquisition and analysis capability, automatic chemical analysis equipment, marine aquaria, a semi-automatic weather station, a complete geology laboratory, and a wide variety of oceanographic and meteorological instruments. Among the expanded laboratory facilities to be provided in the new engineering complex are a 380-foot and 120-foot towing tank (both with random wave generators), on-line data acquisition and analysis capabilities, a coastal engineering basin, a large hyperbaric deep-ocean simulation facility, and a greatly expanded aquarium system for biological oceanographic studies.

The Naval Academy's purpose is to educate midshipmen in preparation for commissioning as career naval officers. Accordingly, midshipmen receive more than 30 semester hours of professional education in the fields of seamanship, tactics, navigation, weaponry, history, law and leadership. Additionally, midshipmen receive a broad liberal arts education in social science and humanities. These studies supplement the normal course of study in an engineering or environmental major and provide a sound foundation for professional development as a naval officer.

The degrees offered are a **B.S. in Marine Engineering**, a **B.S. in Naval Architecture**, a **B.S. in Ocean Engineering**, and a **B.S. with a designated major in Oceanography**.

The marine engineering program places major emphasis on the principles of energy conversion and marine propulsion systems design and analysis for both nuclear and fossil fuel plants. Each student is required to complete at least 30 semester hours of courses in the field of marine engineering.

The naval architecture program encompasses a comprehensive analysis and design of vehicles that operate on, under or just above the air-sea interface. The curriculum covers the static and dynamic analyses of ships, both theoretically and experimentally, as well as basic design techniques. Thirty hours of courses in the field of naval architecture are required.

The ocean engineering program provides the student with a fundamental introduction to the application of engineering in the undersea environment, with particular emphasis on structures, materials, wave mechanics, power, acoustics and life-support systems. At least 31 semester hours are required in the field of ocean engineering.

The oceanography program is primarily oriented toward achievement in the areas of physical oceanography and meteorology. Majors in oceanography must complete courses in mathematics through differential equations, chemistry, physics, biology, geology, naval engineering, fluid physics, and fluid dynamics. The basic course sequence within a major includes general meteorology, general oceanography, and environmental dynamics. Additionally, a midshipman must complete three elective courses from within those offered in the department or from course offerings acceptable to the department chairman, given in the mathematics, physics, chemistry or engineering departments. A total of 34 semester hours are required in major subjects.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Dean of Admissions

United States Naval Academy

Annapolis, MD 21402

UNITY COLLEGE

Unity, Maine 04988

Unity College places great emphasis upon the Aquatic Ecology and Fisheries Programs. A grant from the National Science Foundation has provided the college with a mobile aquatic ecology laboratory. The college is one of a handful that offer an undergraduate degree in aquatic ecology and student interns work for state operated and private fish hatcheries and the Atlantic Salmon Commission.

With a Unity Bachelor of Science degree in Environmental Science with an option in Fisheries or Aquatic Ecology, you will have a broad foundation in natural sciences and strong quantitative skills, together with extensive preparation in your area of interest. An off-campus internship adds full-time work experience to your professional preparation.

Unity College offers a diverse range of technical environmental science degrees: forest technology, wildlife technology, fisheries technology and conservation law enforcement.

For students who have field oriented goals, Unity College can provide the training necessary to step into a job within the natural resource management profession. It must be emphasized that the Associate of Applied Science and Associate of Science degrees are not the first half of a Bachelor's degree.

The following degrees are offered:

1. Bachelor of Science in Environmental Sciences prepares students for professional opportunities or graduate study in natural science. The required courses give all students a fundamental background in the chemical, physical and biological aspects of our environment. If you are a candidate for a Bachelor's degree, you must develop a specialization within the environmental sciences. You can structure your own program or select one of the following: ecology, fisheries, wildlife, aquatic ecology, or forestry.

To meet the requirements for a Bachelor of Science in Environmental Science degree, the student must take the 40-credit Environmental Science core, take 40 credits to develop a program of specialization, and meet the college's general degree requirements. If you structure your own program, you must develop a plan of study that is acceptable to two faculty members (who become your Advisory Committee), the Dean of the College, and the Faculty Academic Committee. The approved plan must be filed with the Dean's Office prior to completion of your 60th credit-hour at the college. The plan must include a statement of goals, a schedule of projects and courses, a list of resources required, and meeting the minimum requirements of the College for the Bachelor of Science in Environmental Science degree. At least 30 hours at the 3000 level or above must be taken in residence; a minimum of 120 hours are required for the degree.

If you choose to do an honors thesis, you must also choose an honors committee to oversee and evaluate this work. If you so choose, and the com-

mittee agrees, you may take an independent study and the senior thesis for up to twelve credits. The thesis generally includes literature research, problem formulation, and problem resolution using basic scientific research methods.

2. Associate in Applied Science. The College offers three Associate in Applied Science (A.A.S.) degrees designed to prepare students for employment in the areas of Forest Technology, Wildlife and Fisheries Technology, and Conservation Law Enforcement. Because these programs are specifically designed to meet professional requirements, they are not as broadly based as the other academic degrees. This program requires that a minimum of 72 credit hours be earned, of which at least 36 have been earned in residence at the College. Twenty-four credit-hours (minimum) must be earned at the Sophomore level or above, and all degree candidates must have an overall G.P.A. of 2.0, be in good standing, and have passed the minimum skills requirement. The last terms must be spent on campus, unless specific approval is granted by the Dean of the College.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman, Environmental Studies Center

Unity College

Unity, ME 04988

(207) 948-3131

THE UNIVERSITY OF ALABAMA

University, Alabama 35486

The University of Alabama Marine Science Program is a component of the Marine Environmental Sciences Consortium (Alabama). Laboratories, instructional facilities, faculty offices and the Office of the Director are located at the Dauphin Island Sea Lab. The marine science program operates the Point aux Pins Marsh Laboratory on a 250-acre natural marsh, and a 75-foot coastal vessel.

An undergraduate, interdisciplinary, double major program in Marine Science is available at The University of Alabama. Program components include: general academic requirements, a single department major in biology, chemistry, or geology, and an interdisciplinary major composed of Marine Science and related courses. Students must plan to spend a portion of their academic studies in residence at the Dauphin Island Sea Lab in order to complete Marine Science course requirements.

A Master's degree in Marine Science (Biology) is offered through the Department of Biology's Aquatic Biology Program.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Chairperson, Department of Biology
The University of Alabama
P. O. Box 1927
University, AL 35486

or,
Coordinator of Graduate Studies
Dauphin Island Sea Lab
P. O. Box 369
Dauphin Island, AL 36528

UNIVERSITY OF ALASKA

Fairbanks, Alaska 99701

Education in the marine sciences is offered through the Marine Science Program in cooperation with the Institute of Marine Science.

The Institute occupies large areas of two buildings in the research complex of the Fairbanks campus. On three floors of one building, custom built in 1974, are located the principle inorganic and organic chemical and biological laboratories and the Institute library. The Resources Building houses the administrative offices and physical, geological, and additional radiochemical, chemical and benthic biological laboratories. Facilities for biochemistry and marine mammal research are located separately. A full range of modern research equipment is maintained for student and faculty research. Support facilities in Fairbanks include publications and drafting departments, glass and electronics shops. Marine facilities are located on the coast at Seward. This is the home port of the 133-foot *R/V Alpha Helix*, and full staging and support shop facilities are maintained together with the necessary administrative offices. This field station also includes three new laboratory and teaching buildings with running seawater facilities, and there is an active permanent biological research group in addition to temporary relocations from Fairbanks. Various other small field stations around the state are utilized as needed.

The Program offers **M.S. degrees in Biological Chemical, Fisheries, Geological, and Physical Oceanography**, and in **Marine Biology**; the **Ph.D. degree** is offered in **Oceanography**. All M.S. degrees require a minimum of 30 graduate credits, including a thesis. Depending on the discipline, students are required to take certain combinations of graduate core courses, and shipboard experience is mandatory. Formal training for the Ph.D. degree is tailored to the individual needs by each graduate advisory committee, and candidates are sometimes sent to other institutions for specialized courses. The mean population is about 45 graduate students and about two Ph.D. degrees are conferred annually.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Head, Marine Science Program
Institute of Marine Science
University of Alaska
Fairbanks, AK 99701
(907) 474-7895

UNIVERSITY OF ARIZONA

Tucson, Arizona 85721

The University of Arizona Marine Sciences Program functions as a teaching, research and advisory unit within the Department of Ecology and Evolutionary Biology of the College of Liberal Arts. Its chief academic functions are to aid undergraduates in preparing for graduate studies in the marine biological sciences, and to provide faculty and graduate students with the means to conduct advanced research in marine ecology in the nearby Gulf of California.

The Marine Sciences Program, begun formally in 1958, was officially established in 1965 with the construction of a small marine biology laboratory at Puerto Penasco, Sonora, Mexico, and a grant from the Office of Naval Research for a visiting investigator program. Since then laboratory facilities have expanded at Puerto Penasco, largely due to the Environmental Research Laboratory's programs in desalination, horticulture and shrimp mariculture in cooperation with the Universidad de Sonora, Hermosilla, Sonora. The Puerto Penasco Marine Biological Station is part of a complex of facilities maintained by the UA Environmental Research Laboratory. This includes an extensive sea water system which uses naturally filtered water from beach wells, which flow at a constant temperature of about $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$. The marine station has a wet and a dry lab as well as a beach house used as a dormitory-classroom for visitors. In addition, the UA Marine Sciences Program operates the *R/V La Sirena*, a 31-foot converted trawler for shallow water oceanography and scuba.

The following degrees are offered:

1. **M.S. in Ecology and Evolutionary Biology.** This degree is offered through the Department of Ecology and Evolutionary Biology. Intended candidates for the M.S. must present a minimum of about 32 hours of undergraduate preparation in biological sciences equivalent to the requirements for an undergraduate major in this department. They should have completed at least one year of chemistry (inorganic), mathematics, through calculus, and a year of physics. Deficiencies in undergraduate preparation must be made up. An official record of the student's performance in the Graduate Record Examination (Aptitude and Advanced test in Biology), a full transcript of undergraduate coursework, and three letters of recommendation are required of all applicants. The student must complete 30 graduate credit units in an approved

graduate study program. Both thesis and non-thesis M.S. programs are available.

2. Ph.D. in Ecology and Evolutionary Biology. Intended candidates for the Ph.D. must present undergraduate coursework as for the M.S. degree. GRE scores, transcripts, and letters of recommendation as described for the M.S. degree are required of all applicants. In addition to the major, a suitable minor area must be selected, and the student must complete an approved, individually-planned graduate study program including coursework in the minor field. An approved dissertation problem is required of all students, and each must pass qualifying, preliminary and final oral examinations, and demonstrate achieved proficiency in one foreign language.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Chairman

Marine Sciences Program

Department of Ecology and Evolutionary Biology

The University of Arizona

Tucson, AR 85721

or, to obtain information about the mariculture program at Puerto Penasco, address inquiries to:

Director

Environmental Research Laboratory

Tucson International Airport

Tucson, AR 85706

UNIVERSITY OF BRIDGEPORT

Bridgeport, Connecticut 06601

The Marine Biology Program of the University of Bridgeport offers *B.A.*, *B.S.*, and *M.S.* degrees with emphasis in Marine Biology.

The *B.A.* curriculum provides a firm subject matter training in basic background sciences: chemistry, geology, mathematics, oceanology, and physics, as well as biology. The student is also introduced to the diversity of humanities: art, literature, music, philosophy, and of the social sciences: history, psychology, sociology and economics.

The *B.S.* curriculum provides an additional training to students in the form of cooperative education or internship study at a marine institution such as the U.S. Marine Fisheries Service Laboratory and Connecticut Shellfish Commission in Milford, Ct., and the Bermuda Biological Station for Research.

A part of the Bachelor's and Master's curricula is the Semester in Bermuda. Graduate students and advanced undergraduate students spend eight weeks at the Bermuda Biological Station for Research during a fall semester. There they examine the marine life in the laboratory and field working with the research scientists at the station. Four courses totaling 14 credits are offered during the student's stay in Bermuda.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Chairman

Biology Department

University of Bridgeport

Bridgeport, CT 06601

(203) 576-4270

UNIVERSITY OF BRITISH COLUMBIA

Vancouver, B.C., Canada V6T 1W5

The Department of Oceanography is part of the Faculty of Science of the University of British Columbia and provides facilities for work toward **Combined Honours B.Sc., Master of Science and Doctor of Philosophy** degrees in Oceanography. Offices and laboratories are on the university campus at Point Grey about six miles west of the center of Vancouver. Field work is carried out on research vessels made available by federal government agencies from the 40-meter C.S.S. *Vector* to the 77-meter C.N.A.V. *Endeavor*. Facilities are available for work in biological, chemical, and physical oceanography, marine geology, geophysics and geochemistry. The department has two LSI-11 computers and the University has an Amdahl 470 V8 Computer. The present research emphases are on phytoplankton ecology and physiology; zooplankton, primary and secondary production; controlled ecosystem experiments, coastal and fjord oceanography; waves and tides; mathematical modelling; dynamics of the upper ocean; satellite remote sensing; sediment geochemistry; ferromanganese nodules; seafloor hydrothermal processes, structure and tectonics of the Juan de Fuca ridge and plate; and ocean-continent crustal structure.

The following degrees are offered:

1. Combined Honours B.Sc. in Oceanography and Biology, Botany, Chemistry, Geology, Geophysics, Physics or Zoology. Four-year program.

a) Entrance requirement is successful graduation for a B.C. Secondary School or equivalent with C+ average with the following required: Algebra 12, Chemistry 11, Physics 11 and an additional Science 12.

b) Sixty-six units of credit (one unit of credit is given for a 25-hour lecture course). At least 15 units with a minimum overall second-class (at least 65%) standing in each academic year.

2. M.Sc. in Oceanography.

a) Entrance requirement is an honours B.Sc. in an appropriate field.

b) Program with thesis requires fifteen units of credit, including at least three and no more than nine units for thesis research.

c) Research and thesis.

d) Final Departmental Thesis defense.

e) Program without Thesis requires fifteen units of credit, a major essay (carrying no credit) and a comprehensive examination.

3. Ph.D. in Oceanography.

a) Entrance requirement is a Master's degree or a Bachelor's degree with first class honours standing, or a successful first graduate year in a Master's program with clear evidence of research ability.

b) Courses as required by supervising committee (minimum of 15 units if directly from B.Sc. degree including first class average for nine units minimum in the first year).

c) Comprehensive examination.

d) Original research and presentation of thesis.

e) Language requirement as determined by supervising committee.

f) Public examination and defense of thesis.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Head

Department of Oceanography

The University of British Columbia

6270 University Boulevard

Vancouver, B.C., Canada V6T 1W5

UNIVERSITY OF CALIFORNIA

Instruction in marine-related topics is available on all interdepartmental UC campuses. Degree programs in the marine sciences or programs with marine specialization are offered at Berkeley (B.S. in Marine Biology and Masters' and Doctoral programs in Ocean Engineering), Davis (B.S. in Wildlife and Fisheries Biology), Irvine (M.S. and Ph.D. programs in Developmental and Cellular Biology or in Ecology and Evolutionary Biology with marine specialization), Santa Barbara (B.A. in Aquatic Biology) and San Diego (graduate instruction leading to M.S. and Ph.D. in Oceanography, Marine Biology and Earth Sciences at Scripps Institution of Oceanography). Institutions, at which no specific marine programs are offered but at which coursework and independent study in marine sciences are possible, are Irvine (B.S. in Biology), Santa Barbara (M.A. and Ph.D. in Biology), and Santa Cruz (B.A. in Environmental Studies).

Since course credits are transferable by consent, all UC campuses offering marine-related instruction are listed. In addition to the campuses listed above, University of California entries for Bodega Marine Lab, Los Angeles and Riverside are included.

UNIVERSITY OF CALIFORNIA BERKELEY

Berkeley, California 94720

UC Berkeley offers marine-related programs in the biological sciences and in engineering. In the life sciences, instruction and research are shared between

the Berkeley campus and the Bodega Marine Laboratory (BML).

BIOLOGY WITH MARINE SPECIALIZATION: University of California, Berkeley, offers a *Bachelor of Science* degree program in Biology with specialization in Marine Biology. The program is billed as a field major, and it serves the needs of students who want a broader training in the biological sciences than is possible in a departmental major. Students enrolled in the program take courses from several fields, including biology, zoology, botany, genetics, chemistry, mathematics, physics, and molecular biology. They must complete a one-quarter course or summer course at a marine laboratory, and at least one course in statistics is strongly advised. To complete the program, students must have at least 45 units of upper division work in the major.

Facilities in the biological sciences include a 500 gallon recirculating seawater system, and a number of small craft for subtidal research maintained by the Zoology Department. The University Herbarium houses one of the largest collections of marine algae in the United States. The Naval Biomedical Research Laboratory, a unit attached to the School of Public Health, has facilities for research on environmental biology and other topics of interest to the U.S. Navy. There is also a research diving program which trains and provides support to faculty and students performing scientific work underwater using scuba.

Research in the marine biology field is conducted at the Richmond Field Station and the Bodega Marine Laboratory. Oceanographic research vessels and ship time are available locally through arrangements with the California Maritime Academy and other local sources. In San Diego, research is conducted through the University's marine facilities at the Scripps Institution of Oceanography.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Chairman

Department of Botany

University of California, Berkeley

Berkeley, CA 94720

(415) 642-1487

OCEAN ENGINEERING. The University of California, Berkeley, offers several graduate level degree programs in Ocean Engineering: **M.S., M.E., Doctor of Engineering, and Doctor of Philosophy in Engineering.**

The Ocean Engineering program is interdisciplinary; it incorporates a wide range of engineering disciplines, including civil engineering, materials science, mineral engineering, mechanical engineering, and naval architecture.

Graduate students in the ocean engineering program study a multitude of marine-related engineering programs, such as air-sea interactions, coastal engineering, corrosion in sea water, desalination, marine and offshore construction, harbor design, marine geo-

physics, waste disposal, engineering properties of marine sediments, ocean mining and prospecting, oceanographic data analyses, marine sediment transport, ocean energy, oceanographic instrumentation, offshore platforms and pipelines, marine and estuarine pollution control, oceanographic vehicles, and properties of engineering materials in sea water.

Research is conducted chiefly in the various laboratories on the Berkeley campus and at the Richmond Field Station, Bodega Marine Laboratory, and Scripps Institution of Oceanography. Oceanographic research vessels and ship time are available locally through working arrangements with the California Maritime Academy and other sources, and in San Diego for world-wide operations through the University's marine facilities at the Scripps Institution of Oceanography.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Chairman

Department of Civil Engineering
217 McLaughlin Hall
University of California, Berkeley
Berkeley, CA 94720
(415) 642-5672

or,

Chairman

Department of Naval Architecture
210 Naval Architecture Building
University of California, Berkeley
Berkeley, CA 94720
(415) 642-5464

UNIVERSITY OF CALIFORNIA, BODEGA MARINE LABORATORY

Bodega Bay, California 94923

The Bodega Marine Laboratory (BML) is a research and teaching facility of the University of California which provides support for degree programs offered by the academic departments of the Berkeley and Davis campuses. Undergraduate and graduate courses are offered at BML and graduate students are in full-time residence conducting thesis research. Admission of students to the degree programs is controlled by the academic departments and graduate divisions of the university campuses.

The laboratory is situated on a 326-acre biological refuge located on the outer coast of Bodega Head; the property includes more than a mile of rocky shoreline, short stretches of sandy beach, and mixed mud and sand flats in Bodega Harbor. The main laboratory building houses 25 modern research laboratories and two teaching laboratories. A newer Aquaculture Facility contains additional research laboratories devoted to a variety of projects investigating aspects of marine aquaculture. Equipment and facilities are available for work in biochemistry, physiology, developmental biol-

ogy, aquaculture, microbiology, ecology, botany, zoology, and marine geology. Most individual laboratories and classrooms are provided with running filtered seawater and seawater tables for experiments and for holding animals. Additional larger tanks and seawater facilities are available in special aquarium rooms. In-board and outboard powered vessels are available to support shallow water coastal research as well as harbor and estuary work.

The degrees of **Master of Arts** and **Doctor of Philosophy** in botany, zoology, geology, endocrinology, nutrition, pathology and genetics are offered by the graduate division of the Berkeley and Davis campuses for research conducted at the Bodega Marine Laboratory.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director

Bodega Marine Laboratory
P.O. Box 247
Bodega Bay, CA 94923

UNIVERSITY OF CALIFORNIA, DAVIS

Davis, California 95616

WILDLIFE AND FISHERIES BIOLOGY: The University of California, Davis, offers a Bachelor of Science degree program in wildlife and fisheries biology with specialization in fisheries. Although the program is not clearly defined as a marine science-oriented program, students can take marine-oriented options to complete major requirements in fisheries (e.g., oceanography, invertebrate biology). Elective courses are also available at the Bodega Marine Laboratory.

The following degrees are offered:

1. **B.S. in Wildlife and Fisheries Biology** with a Fisheries option.

2. **M.A. and Ph.D.** degrees are available through Ecology, Physiology, and Animal Behavior Graduate Groups.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairperson

Wildlife and Fisheries Biology Department
University of California, Davis
Davis, CA 95616
(916) 752-6586

GEOLOGY DEPARTMENT: No specific facilities for geological studies are available within the department, however, facilities at Bodega Marine Laboratory are available to our students.

The following degrees are offered:

1. **A.B. and B.S. degrees in Geology** (specialization in Marine Geology is available).

2. **M.S. degree in Geology** with Marine Science emphasis; 30 units required, plus thesis.

3. **Ph.D. degree in Geology** with Marine Science emphasis; dissertation required.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Graduate Advisor
Department of Geology
University of California, Davis
Davis, CA 95616

DEPARTMENT OF ZOOLOGY: The following degrees are offered:

1. **M.A. in Zoology**

- a) Thirty-six credits including credit for thesis research.
- b) Successful completion of a First Year Examination in General Zoology.
- c) Presentation of a Master's thesis.

2. **Ph.D. in Zoology**

- a) There are no course requirements; a First Year Advisory Committee advises each Ph.D. student on the course of study.
- b) Successful completion of a First Year Examination in General Zoology.
- c) Successful completion of an Oral Qualifying Examination at the beginning of the third year.
- d) Presentation of a Ph.D. thesis.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Graduate Advisor
Department of Zoology
University of California, Davis
Davis, CA 95616

UNIVERSITY OF CALIFORNIA, IRVINE
Irvine, California 92717

The main campus is at Irvine, located four miles from rocky intertidal and one mile from estuarine shores. Research equipment includes numerous environmental growth chambers, specific ion probes, pH meters, oxygen analyzers, spectrophotometers, microscopes and photographic equipment. The School of Biological Sciences contains four departments (Molecular Biology and Biochemistry, Developmental and Cell Biology, Ecology and Evolutionary Biology, Psychobiology). Undergraduate teaching is organized on a School basis with graduate programs in each department.

The following degrees are offered:

- 1. **B.S. (Biological Sciences)** 45 course credits (180 quarter units).
- 2. **M.S. (Developmental and Cell Biology or Ecology and Evolutionary Biology).**
 - a) Non-thesis degree with specialization in ma-

rine biology (nine upper division or graduate courses, followed by a comprehensive examination).

b) Thesis degree with specialization in marine biology (seven upper division or graduate courses with presentation of a thesis).

3. **Ph.D. (Developmental and Cell Biology or Ecology and Evolutionary Biology).** Requires nine upper division or graduate courses, followed by a comprehensive examination and presentation of a thesis.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chair
Department of Ecology and Evolutionary Biology
University of California, Irvine
Irvine, CA 92616
(714) 833-6006

**UNIVERSITY OF CALIFORNIA,
LOS ANGELES**
Los Angeles, California 90024

Although there is no specific degree program at UCLA concerned only with marine science, it is possible to specialize in many aspects of marine science through existing undergraduate and graduate degree programs attached to individual departments and schools. In this way, the considerable faculty and material resources of this large campus are brought to bear on the marine environment, aided by resource-sharing arrangements with neighboring campuses, notably the Scripps Institution of Oceanography of the University of California, San Diego, and other nearby institutions, such as the University of Southern California.

Courses in marine science and related fields are offered through several major departments and schools, notably Biology, Engineering and Applied Science, Geography, Geology, Kinesiology, Microbiology and Immunology, and Physiology. In addition, faculty in several other departments and schools are actively engaged in marine-related research, notably in Architecture and Urban Planning, Law, Management, Nuclear Medicine and Radiation Biology, and the Center for Health Sciences with its many departments.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Undergraduate Admissions and
Relations with Schools
University of California, Los Angeles
Los Angeles, CA 90024

or,

Graduate Admissions
University of California, Los Angeles
Los Angeles, CA 90024

UNIVERSITY OF CALIFORNIA, RIVERSIDE

Riverside, California 92502

The University of California, Riverside is a member of the consortium that operates the Catalina Marine Biological Laboratory. (See listing for the University of Southern California for further information.)

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Department of Earth Sciences

University of California, Riverside

Riverside, CA 92502

UNIVERSITY OF CALIFORNIA, SAN DIEGO SCRIPPS INSTITUTION OF OCEANOGRAPHY

La Jolla, California 92093

The Scripps Institution of Oceanography has been associated with the University of California since 1912. It is now part of the University of California, San Diego campus, with 11 major buildings clustered on the ocean shore north of the center of La Jolla.

Special facilities include: the SIO Library with more than 140,000 volumes; radio station WWJD, operated by the U.S. National Marine Fisheries Service; the Scripps pier, 1,000 feet long, housing apparatus for a number of serial oceanographic observations and used as a landing place for skiffs; the salt water system providing clean seawater to the aquarium and biological laboratories; an underwater area for research and collecting offshore from the institution; deep-sea sediment cores from several thousand widely scattered localities and original echograms and underway geophysical data along several hundred thousand miles of ships' tracks in the oceans of the world; an oceanographic data archive of some half a million bathythermograph observations; electron microprobe laboratories; nine mass spectrometers; several thousand samples of sea water from the world oceans; an electron microscope laboratory; the Scripps fish collection of more than 2,000,000 specimens of some 3,100 species of marine fish, and oceanic samples of plankton. Scripps scientists have access to the University's computer center and have a shipboard computer group with computers on several of the larger ships in the fleet as well as another on the SIO campus.

The Institution operates four ships specially fitted for oceanographic research: *E.B. Scripps*, *New Horizon*, *Thomas Washington*, and *Melville*, and two research platforms: FLIP (Floating Instrument Platform) and ORB (Oceanographic Research Buoy).

The Graduate Department of the Institution offers graduate instruction leading to *M.S. and Ph.D. degrees* in oceanography, marine biology and earth sciences. Approximately 25 doctorates are awarded each year. Emphasis is on the Ph.D. program, although the M.S. is awarded if circumstances warrant, either on a comprehensive examination plan or on a thesis plan. No undergraduate major is offered in the department, although most courses are open to enrollment for qualified undergraduate students, with consent of the instructor. Graduate students normally concentrate on one of several curricular programs within the department, including: biological oceanography, marine biology, marine chemistry, geology sciences, geophysics, physical oceanography, and applied ocean sciences. The last is carried out as a joint program with the Department of Applied Mechanics and Engineering Sciences and the Department of Electrical Engineering and Computer Sciences. The interdisciplinary nature of research in marine sciences is emphasized, and students are encouraged to take courses in several programs and departments and to select research problems of an interdisciplinary nature. The department has no formal language requirements, although some curricular groups require one of two languages or demonstration of ability to use certain foreign languages pertinent to a student's research.

Candidates for admission should have a Bachelor's or Master's degree in one of the physical, biological or earth sciences; in some cases, a degree in mathematics or engineering science is accepted. The student's preparation should include a solid background in mathematics, physics, chemistry, biology, geology, and prior study of at least one foreign language. All students are normally required to take a departmental examination, and the student is expected to demonstrate a comprehension of required subject materials and of the pertinent interactions of physical, chemical, biological or geological factors. After the student has passed the departmental examination and has completed an appropriate period of additional study, the department recommends the appointment of a Doctoral Committee. This committee determines the student's qualification for independent research by means of a qualifying examination and supervises the student's performance and reporting of research. A requirement for the Ph.D. degree is the submission of a dissertation based on original research and a final examination at which time the thesis is publicly defended.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Graduate Department A-008

Scripps Institution of Oceanography

La Jolla, CA 92093

(619) 452-3206

**UNIVERSITY OF CALIFORNIA,
SANTA BARBARA**
Santa Barbara, California 93106

Marine research and teaching facilities are housed in a marine laboratory complex and portions of other departmental buildings. These marine facilities form part of the general university campus — located at seaside — and are in close proximity to other science and engineering departments, the library (1,200,000 volumes), and computer center. Marine laboratories in several buildings are provided with excellent seawater service, from a new seawater system, and are suitably equipped for needs in a broad range of biological and other disciplines. Field-oriented work is supported by boats, suitable for work in coastal waters (including those around the Santa Barbara Channel Islands), and by diving and other field equipment. The University operates a field station on Santa Cruz Island, the largest of the northern Channel Islands. The Department of Biological Sciences offers an undergraduate major in Aquatic (marine and freshwater) Biology. Graduate students in Biology may take higher degrees (M.A. or Ph.D.) with an emphasis in Marine Biology. Additional marine courses are offered by the Geological Sciences, Engineering, Environmental Studies, Geography, and History departments. There are 61 faculty and professional researchers active in marine research. Marine activities in the biological and geological sciences presently predominate, but there is increasing involvement of researchers from Political Science, Engineering, Chemistry, Geography and History.

Degrees offered and their requirements are as follows:

1. The **B.A. in Aquatic Biology** requires as preparation: 12 units General Chemistry; 10-16 units Organic Chemistry; 12-15 units Calculus; 12-15 units General Physics; 14 units Introductory Biology. In the junior and senior years students must complete at least 38 units in upper division Biology, Botany, and Zoology, of which 16 fall within specifically required courses.

2. The **M.A. in Biology, Botany and Zoology** is offered under two plans:

a) Thesis degree with specialization in marine biology requires 30 units and acceptance of thesis.

b) Non-thesis degree with specialization in marine biology requires 36 units and passing of comprehensive examinations.

3. The **Ph.D. in Biology** specifies no minimum number of units but requires a minimum two-year residence, with at least four units to be undertaken per quarter. Comprehensive examinations must be passed in major and minor fields, and competence must be demonstrated in a modern foreign language.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director, Marine Science Institute

University of California, Santa Barbara
Santa Barbara, CA 93106
(805) 961-3764

or,

Chairman

Department of Biological Sciences

University of California, Santa Barbara

Santa Barbara, CA 93106

(805) 961-2415

**UNIVERSITY OF CALIFORNIA,
SANTA CRUZ**

Santa Cruz, California 95064

The Santa Cruz campus of the University of California is located about 75 miles south of San Francisco on 2,000 acres overlooking Monterey Bay and the Pacific Ocean. The Center for Coastal Marine Studies is the multi-disciplinary unit responsible for coordination of activities concerned with marine problems and for the development of facilities needed to support research and instruction in the marine province.

Research facilities include general-access analytical laboratories, walk-in algal and invertebrate culture rooms, a histology room, a cruise-staging area and storage rooms; all located on the main campus. The Joseph M. Long Marine Laboratory, an onshore marine station within a ten minute drive from campus, has two research buildings with running seawater and outdoor tanks for small marine mammal research available, as well as a small public aquarium, office, and shop. Plans are underway, which include a large tank for marine mammal research, and education/bio-research building. Access to nearshore waters is provided by the *R/V Scammon*, a 40-foot vessel. Fund-raising for a 55-foot replacement, which would be specifically designed for neritic research in central California, is underway. A 16-foot Boston whaler and smaller craft are available. The Center also coordinates research activities at Ano Nuevo Island, a major pinniped rookery and haul-out area about 19 miles north of Santa Cruz.

There is no undergraduate major in marine sciences. Undergraduate students interested in marine sciences should major in a discipline such as biology, chemistry, earth sciences, or physics, and take marine-related electives. Students with a bachelor's degree in one of the disciplines can apply for admission to the graduate program through the Graduate Division. *Doctorate degrees* are offered in the relevant science disciplines (i.e., biology, chemistry, earth sciences, physics), and students must meet requirements of the department and undertake a marine-related thesis research problem. In addition, there is a *Marine Sciences Master's Program*. Qualified undergraduates may apply to the Master's program during their junior or senior year, complete their Bachelor's degree at the end of their senior year, and their Master of Science degree with completion of their thesis in their fifth year. Students

with Bachelor's degrees from other Universities may also be eligible for this program but it is expected that the Master's will take two years to complete. Four pathways are available: biology, chemistry, earth sciences, and physics, some of which are divided into several options. The degree combines specified courses to provide breadth in marine sciences with a focused thesis to provide depth and experience in original research. Graduates from the program are in a good position to take research or management positions in organizations concerned with the marine environment, or enter doctoral programs in one of the marine sciences.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director

Center for Coastal Marine Studies

University of California, Santa Cruz

Santa Cruz, CA 95064

UNIVERSITY OF CHICAGO

Chicago, Illinois 60637

The marine sciences program at the University of Chicago is within the Department of the Geophysical Sciences, located in the Henry Linds Laboratory for the Geophysical Sciences. The central core of the building consists almost entirely of research laboratories and associated shop facilities. Among these are several wave tank laboratories which include wave tanks up to 80 feet long used for impulse wave and ocean wave studies, random wave and interaction studies, and internal wave investigations. Other facilities include a flume, wind tunnel, paleoecology laboratory, sedimentology laboratory, hydrodynamics laboratory, geochemistry laboratories, an electron microprobe, and X-ray diffraction equipment. The University Computing Center is nearby. Field facilities are available through cooperation with the Woods Hole Oceanographic Institution.

Degrees are not offered specifically in the marine sciences or oceanography. The M.S. and Ph.D. degrees in the Geophysical Sciences are offered with specialization in the areas included within the marine sciences.

1. **Master of Science** (Geophysical Sciences). The requirements for this degree are: a program of study approved by the departmental counselor, normally consisting of nine graduate courses (at least three basic science courses and at least three geophysical science courses, and at least one research course); courses in basic science may be taken in or outside the department, and an average grade of not lower than B and no grade lower than C in the courses offered for the degree.

2. **Doctor of Philosophy** (Geophysical Sciences). The requirements are: a program of study approved by the

student's advisory committee; pass a reading comprehension examination in a foreign language, a preliminary examination consisting of a written part covering fields that the student has selected for his program of study, followed by an oral part based on the student's proposal for a dissertation topic that he has submitted as a research prospectus, and a dissertation by the candidate on the results of independent research in the geophysical sciences, followed by an oral final examination on the dissertation and the field of specialization.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Department of Geophysical Sciences

The University of Chicago

5734 South Ellis Avenue

Chicago, IL 60637

THE UNIVERSITY OF CONNECTICUT MARINE SCIENCES INSTITUTE

Avery Point, Groton, Connecticut 06340

The Marine Sciences Institute of the University of Connecticut is located at Avery Point in Groton, on the campus of the Southeastern Branch of the University, opposite New London, where the Thames River meets Long Island Sound. Here the Institute occupies two buildings, with a total of more than 50,000 square feet of space, housing laboratories including a Class 100 Ultra Clean Laboratory for trace metal analysis, offices, shops, and classrooms. The Avery Point facilities are used for research and teaching in chemical and physical oceanography, marine geology, geophysics and marine ecology.

A second facility is located in Noank at the mouth of the Mystic River; it includes a 7,000 square foot building, housing laboratories, offices, a shop, and a marine biology library. The building is used exclusively for biological studies; it contains a continuous salt-water system, a 1,500 gallon aquarium and conventional laboratory equipment to conduct fisheries and biological research.

The Institute has a fleet of small boats docked along a 125-foot long pier at the Noank facility. The fleet consists of a 65-foot T-boat, the steel-hulled *R/V Uconn*; a 34-foot lobster boat, the *Libinia*; a 24-foot Sea Ray, the *Husky*; a whaleboat, several Boston Whalers, and smaller skiffs. Personnel to man these boats are located at Noank.

The Institute's marine library was started in 1969 and has continued to grow; it now includes more than 5,000 publications. An IBM 3774 reader/printer remote computer terminal provides access to the University

IBM 370/155/168 computer over leased telephone lines. The Institute has basic research equipment used for conducting investigations in oceanography and related fields. Laboratory instruments include an x-ray diffraction unit; a gas chromatograph, infra-red and UV-visible spectrophotometers, atomic absorption spectrophotometers, anodic stripping equipment, and conventional equipment used in marine geological laboratories. Sea-going instruments include corers, dredges, underwater cameras, plankton nets, current meters, a towed magnetometer, a seismic air gun and sparkers, and sonobuoy.

Also on hand are: magnetometers, an anemometer and wind vane (to record windspeed and direction), a standard air temperature thermograph, a barograph and a tide gage. These data are available for research purposes. At Noank, a tide gage and older meteorological instruments have been making continuous recording since 1958.

The following degrees are offered:

1. **Master of Science in Marine Biology and Oceanography** - 15 credits of advanced coursework and a thesis.

2. **Doctor of Philosophy in Oceanography** - completion of 24 credits of advanced coursework, a reading knowledge of French, German or Russian, and a dissertation.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

The Director

Marine Sciences Institute

The University of Connecticut

Avery Point, Groton, CT 06340

UNIVERSITY OF DELAWARE

Newark (19711) and Lewes (19958), Delaware

Graduate programs in oceanography and marine studies are offered through the College of Marine Studies. Other units in the University, such as the school of Life and Health Sciences and the Departments of Geology, Geography, and Civil Engineering offer undergraduate and graduate degrees with marine specializations. A marine direction may also be taken in the Department of Physics and the Department of Food Science and Nutrition.

COLLEGE OF MARINE STUDIES: Interdisciplinary programs of study leading to a master's or doctoral degree are available in oceanography, applied ocean science, marine biology and biochemistry, and marine policy. The oceanography program uses an integrated approach to provide students with a blend of the basic and applied sciences necessary to conduct research in biological, chemical, physical, or geological oceanography. The marine biology and biochemistry program

offers programs in ecological, organismic, functional or applied marine biology, and marine biochemistry. Applied ocean science students may select an option in remote sensing, marine materials and corrosion, living aquatic production systems, marine energy systems and instrumentation, coastal geology, marine transportation systems, marine geophysics and acoustics, or geophysical fluid dynamics. Students in the marine policy program prepare themselves for professional work in managing the legal, political and economic aspects of the ocean, its coastline or its resources. Students in one discipline are required to take introductory coursework in the other disciplines.

The College of Marine Studies is dedicated to the conduct of marine research of significance to the region, the state and the nation. Focusing primarily on estuaries, the coastal zone and the continental shelf, research is an integral part of the student's program. The student, working under the supervision of his adviser, is expected to demonstrate ability to identify, define, and solve a problem in his or her area of interest through the thesis presentation. Faculty research, often sponsored by outside granting agencies such as the National Science Foundation, NASA, the National Sea Grant Program, various state agencies or industry, may provide the funds for graduate assistantships.

The facilities of the College of Marine Studies are located on the main campus of the University of Delaware in Newark and at its Marine Studies Complex in Lewes, Delaware. On the main campus, Robinson Hall houses administrative and faculty offices, classrooms, and laboratories. The resources and facilities of allied departments, the University library, and the computing center are nearby. In Lewes, near the mouth of the Delaware River, the College has additional classrooms, faculty and administrative offices, laboratories, a conference center, and a small harbor where its 120-foot research vessel, *R/V Cape Henlopen*, as well as a few other boats, are moored. A large wind/wave/current tank is also available in Lewes.

The degrees offered are:

1. **Master of Science in Marine Studies** (with areas of concentration in oceanography, applied ocean science, or marine biology and biochemistry)

2. **Master of Marine Policy**

3. **Doctor of Philosophy, Marine Studies** (with concentration in applied ocean science, marine biology and biochemistry, or marine policy)

4. **Doctor of Philosophy, Oceanography**

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Academic Affairs Coordinator

College of Marine Studies

University of Delaware

Newark, DE 19711

(302) 738-8166

SCHOOL OF LIFE AND HEALTH SCIENCES: offers the following degrees:

1. **Bachelor of Arts** (with option in marine biology)
2. **Master of Science** (with specialization in marine biology)
3. **Doctor of Philosophy** (with specialization in marine biology)

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director
School of Life and Health Sciences
University of Delaware
Newark, DE 19711
(302) 738-2281

GEOGRAPHY DEPARTMENT: offers the following degrees:

1. **Bachelor of Arts**
 2. **Master of Arts or Master of Science**
- Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman
Department of Geography
University of Delaware
Newark, DE 19711
(302) 738-2294

GEOLOGY DEPARTMENT: offers the following degrees:

1. **Bachelor of Science**
 2. **Master of Science in Geology**
 3. **Doctor of Philosophy in Geology**
- Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairperson
Department of Geology
University of Delaware
Newark, DE 19711
(302) 738-8458

CIVIL ENGINEERING: Ocean engineering courses are offered both at the main campus in Newark and at the College of Marine Studies complex in Lewes. On-campus laboratory facilities are located primarily within the Departments of Civil Engineering and Mechanical and Aerospace Engineering. The fluid mechanics laboratory contains a combined towing and wave tank with eight-foot by five-foot test section, a 90-foot long wave tank, a free surface hydrodynamic tank with a four-foot by six-foot test section, a rotating flow table and a ripple tank. A number of oceanic research vessels and a 50-foot by 50-foot wave basin are frequently used facilities at Lewes.

The environmental engineering laboratories are equipped for chemical and biological analyses of water. Specialized equipment includes stability indicator, turbidimeter, BOD apparatus, Kjeldahl N viscometer, Warburg respirator, CHN analyzer, TOC analyzer, biological process pilot plant, and a C.O. probe accurate to one part per billion of dissolved oxygen.

Well equipped soil mechanics, metallurgical and structural laboratories are also available for marine-oriented research.

The degrees offered are:

1. **Bachelor of Civil Engineering** (with some specialization in Ocean Engineering)
 2. **Master of Civil Engineering** (with specialization in Ocean Engineering)
 3. **Doctor of Philosophy in Applied Science** (with specialization in Ocean Engineering)
- Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Ocean Engineering Program
c/o Chairman, Department of Civil Engineering
University of Delaware
Newark, DE 19711
(302) 738-2441

PHYSICS DEPARTMENT: offers the following degrees:

1. **Bachelor of Arts or Bachelor of Science in Physics**
 2. **Bachelor of Science in Geophysics**
 3. **Master of Science and Doctor of Philosophy in Physics**
- Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairperson
Department of Physics
University of Delaware
Newark, DE 19711
(302) 738-2261

FOOD SCIENCE AND HUMAN NUTRITION: offers the following degrees:

1. **Bachelor of Science** (Food Science)
 2. **Master of Science** (Food Science)
- Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairperson
Department of Food Science and Human Nutrition
College of Human Resources
University of Delaware
Newark, DE 19711
(302) 738-8979

UNIVERSITY OF FLORIDA Gainesville, Florida 32611

The University is involved in a broad array of marine-related activities beyond formal curricula. The specialized facilities discussed below are directly used in education. For the most part, the University of Florida's curricula in the marine sciences are formally established at the graduate level, wherein a student conducts research and is permitted broad flexibility in coursework.

Off-campus laboratories provide easy access to both the Gulf and Atlantic coasts. Within an hour's drive the superb variety of marine and estuarine communities of the Gulf of Mexico is available through the facilities of the University of Florida Marine Laboratory on Seahorse Key, which is located three miles offshore, opposite Cedar Key. Living accommodations are provided in a 10-room lighthouse and a 20- by 40-foot laboratory building, complete with running sea water available for research use. The Laboratory maintains a 33-foot research vessel equipped for dredging, trawling, and scuba work and a number of smaller outboard-powered boats for shallow water and inshore use. A dock and marine railway are situated next to the Laboratory. The location at Seahorse Key provides ease of access to diverse habitats ranging from freshwater rivers, estuaries and salt marshes to the marine water of the Gulf of Mexico. Clark Island and the surrounding waters, amounting to 41 acres, located near Seahorse Key belong to the University of Florida. This undisturbed area is available for use in intensive studies of estuarine resources and processes. The Florida Institute for Oceanography (FIO) provides deep-water oceanographic vessels for University personnel, thus extending the capabilities of the Laboratory. Ship time is obtained upon approval of submitted proposals to FIO.

The C.V. Whitney Marine Research Laboratory at Marineland in Flagler County on the Atlantic coast is only two hours away from Gainesville and offers modern facilities for biochemical, behavioral, biomedical, fish and marine mammal research. The habitats available for study here include those associated with a high-energy coastline as well as the unique coquina rock outcrop. Both laboratories have accommodations for extended stays.

The Marine Biology Program is part of the curriculum of the Department of Zoology. On-campus facilities for a wide range of experimental programs include two large saltwater aquarium rooms, controlled environmental chambers, culture rooms, data-sensing instrumentation, standard analysis laboratories, scanning and transmission electron microscopes, mini-computers, and terminals for access to the University computer Center. The Florida State Museum, adjacent to the Department's Bartram Hall, maintains significant collections available for research purposes. The program in Marine Biology receives interdisciplinary support from faculty and facilities drawn from other units within the University, including Botany, Geology, Microbiology and Cell Science, Medicine, Pharmacy, Environmental Engineering, Florida State Museum, Biochemistry, Communication Sciences, Coastal and Oceanographic Engineering, Statistics, Computer Science, Food Sciences, Wildlife and Resource Management, Center for Wetlands, Sea Grant and the Marine Advisory Service. Research and class cruises, provided by FIO and the University of Florida Marine Laboratory, give essential training and experience in gear handling, sam-

pling techniques, and analysis of marine community structure. The Department of Zoology offers programs of study leading to the M.S. and Ph.D. degrees with research specializations in most areas of classical and experimental zoology, including a broadly based program in marine biology. Among the areas of current emphasis are basic and applied studies in marine ecology, zoogeography, sensory physiology, ichthyology, systematics, population genetics, and ethology.

The Communication Sciences Laboratory is located in the Department of Speech. Created in 1965, the laboratory has a full-time faculty of 18 and is devoting considerable effort to underwater speech communication. This work is supported by the U.S. Navy and utilizes six Navy laboratories including their research station at Bugg Springs in the central portion of the state.

The Florida State Museum serves as a center for research in anthropology and natural history. Strongly oriented toward basic research, it carries a dual responsibility as both the state and university museum. Of particular interest to the aquatic sciences are the collections of reptiles, amphibians, fishes and mollusks. Completion of a new museum facility on the campus adjacent to the life sciences building complex has afforded a greatly increased opportunity for research, interpretive displays and an even greater level of cooperation with other units of the University. The new facility includes aquarium rooms which will be of value to many areas of the aquatic, estuarine and marine sciences.

The academic and research programs in the Coastal and Oceanographic Engineering Department are oriented toward the physical aspects of coastal and ocean engineering. Both basic and applied laboratory and field studies are conducted in the Coastal Laboratory in Gainesville and at numerous locations on the coast of Florida. The Laboratory facilities include: large, enclosed areas for hydraulic model studies; an air-sea interaction facility with random wave generation capability; two stratified flow-internal wave facilities for studying stratified shear flows, subsurface wave phenomena, flow stability, horizontal dispersion in bays, etc.; a wave tank in which the effects of waves on structures, sand motion and other variables can be investigated; a hydraulic tilting flume as well as a rotating ring-channel system for basic studies of the interaction of flows with sediments. A coastal data network consisting of bottom mounted pressure transducers located approximately one kilometer offshore at numerous locations around the state connected to shore and the telephone system by underwater cables allow real time wave and tide measurement from the central computer in the Coastal Laboratory in Gainesville.

Research presently being conducted includes the following general areas: nearshore sediment transport, beach and dune erosion under storm conditions, waves, friction factors associated with arrested salt wedges,

tidal inlet hydraulics and stability, marina siltation and water quality problems, nature assisted beach nourishment, prediction of hurricane-associated sea severity, and criterion for the establishment of a coastal construction setback line.

The Florida Sea Grant College is administered at the University of Florida on behalf of the State University System of Florida and affiliated private institutions. Faculty and their students in many departments, including food science, veterinary medicine, nursing, architecture, forestry, and others not offering many marine-oriented courses, have received Sea Grant support.

The following graduate degrees are offered:

1. **Master of Science and Ph.D. in Botany.** Requirements include core undergraduate courses and recommendations of the supervisory committee.

2. **Master of Science, Master of Engineering, Engineer in Coastal and Oceanographic Engineering.** The Ph.D. degree is offered through one of the other departments in the College of Engineering. A Bachelor's degree in engineering or physical sciences or articulation work is necessary for acceptance to the program.

3. **Master of Science in Geology.** Required are the core undergraduate courses and a recommended summer field course.

4. **Master of Science and Ph.D. in Zoology.** Requirements are the core curriculum and recommendations of the supervisory committee based on written examinations.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director

Center for Aquatic Studies

2001 McCarty Hall

University of Florida

Gainesville, FL 32601

UNIVERSITY OF GEORGIA

Athens, Georgia 30602

At the University of Georgia, faculty members in several departments, including Botany, Zoology, Microbiology, and Geology, and the School of Forest Resources, are actively involved in marine research and offer marine-oriented courses. The University of Georgia, however, does not offer a degree in marine biology, marine ecology, oceanography, or other fields of marine science at either the undergraduate or graduate level.

Students interested in attending the University of Georgia to pursue marine sciences may apply for admission to the department of their primary interest. Another option available for students interested in a Ph.D. degree in marine ecology is the Ecology Degree

Program, an interdisciplinary program established several years ago to provide students with an opportunity to obtain the Ph.D. degree of the traditional department mode.

Faculty members who participate in marine research and education at the University of Georgia and the University System's Skidaway Institute of Oceanography comprise a Marine Sciences Faculty. Representation in this Marine Sciences Faculty presently includes the University of Georgia's Marine Institute on Sapelo Island and Marine Extension Service at Brunswick and Savannah, the Departments of Botany, Zoology, Microbiology, and Geology, School of Forest Resources, and the Skidaway Institute of Oceanography at Savannah.

The University of Georgia's coastal facilities include the Marine Institute on Sapelo Island, the Marine Resources Center on Skidaway Island, and the Fisheries Extension Station at Brunswick. Also located on Skidaway Island is the University System's research facility, the Skidaway Institute of Oceanography.

The Marine Institute is located on the southern end of Sapelo Island. Primarily a research facility, it is involved mainly with marsh ecological research. Current interests are focused on energy flow in the marsh ecosystem, cycling of materials and nutrients through the marshes, and factors regulating the metabolism of the marsh ecosystem. A staff of 36 scientists, technicians, and support personnel is in residence throughout the year. The Marine Institute also serves as a research site for faculty members and graduate students based on the main campus at Athens. Formal courses are not offered at the Marine Institute. Physical facilities of the Marine Institute include several laboratory buildings, residences, trailers, dormitories, dining hall, boat house and maintenance shops. The Institute operates the 44-foot *Spartina* and other small boats.

The Marine Resources Center is located on Skidaway Island, outside of Savannah. Since 1973, it has served as the major site in the State for marine educational programs designed to supplement the curricula of pre-college, undergraduate and graduate level science classes. The building has aquarium facilities for exhibiting live specimens common to Georgia coastal waters, other instructional exhibits, seminar and lecture rooms, and laboratories with running seawater. Dormitory and dining facilities are available. A staff of 20, including scientists, technicians, and support personnel is in residence.

The Center serves as a field station for schools and colleges in Georgia where teachers can bring their science classes to obtain direct experience with the marine environment.

The Fisheries Extension Center, with a staff of 17 is located at Brunswick. It assists the seafood industry, including fishermen and processors, and other marine-related industries to increase their efficiency and capabilities through programs of applied research, advisory services, and training. The Brunswick area is a

major site for the shrimp industry in Georgia. The Fisheries Center operates the 73-foot shrimp boat *Georgia Bulldog* to provide training, carry on gear research, conduct resource assessment studies, and exploratory offshore fishing.

A major effort of the Fisheries Center is to provide advisory assistance to the seafood processing industry in regard to seafood waste disposal, quality control, and in plant sanitation.

The Skidaway Institute of Oceanography serves as a marine research facility for the University System. The Skidaway Institute and the University of Georgia's Marine Resources Center are located on the northern end of Skidaway Island.

A staff of 75 scientists, technicians, and support personnel are in residence. The Institute operates the *R/V Bluefin*, a 75-foot shrimp boat modified for coastal oceanographic research, the 42-foot *Morgan J*, and a number of small boats.

Research interests are focused on the continental shelf and include studies of phytoplankton, zooplankton, and benthos, and physical, chemical and geological oceanography. Another major effort is devoted to the study of pollutants (petroleum, heavy metals) in marine waters.

The Skidaway Institute does not offer courses or degrees, but many of its staff members hold adjunct appointments at the University of Georgia, Georgia Institute of Technology, and Georgia Southern. They serve as major advisors to graduate students from various universities and colleges.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Graduate Coordinator
(Department of Interest)
University of Georgia
Athens, GA 30602

UNIVERSITY OF GUAM

Agana, Guam 96910

The University of Guam Marine Laboratory has research and teaching facilities located on the shores of Pago Bay adjacent to the main campus.

The 19,000 square-foot research building provides research and teaching laboratories and offices and features a flowing-seawater system. The 3,300 square-foot technical building provides workshop facilities and maintenance and storage space. Fourteen, 18 and 21-foot boats are available for nearshore and reef studies, which are the main emphasis of the laboratory. Research equipment includes oxygen and pH meters, specification probes, spectrophotometers, microscopes, photographic equipment, diving gear, and a variety of field sampling gear. More sophisticated laboratory

equipment, including an atomic absorption spectrophotometer and a gas chromatograph are available in other research laboratories on the main campus. Extensive reference and research collections, containing several thousand species of plants and animals, are available. The University publishes the journal *Micronesica*, devoted to the natural sciences of Micronesia and related areas.

The following degree is offered:

M.S. in Biology with an emphasis available in tropical marine biology.

a) Thirty graduate credits, including Biometrics, Biological Literature and Writing, and six hours of thesis research.

b) Comprehensive oral examination.

c) Completion of thesis and oral defense.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Coordinator

Graduate Program in Biology

Marine Laboratory

University of Guam

P.O. Box EK

Agana, Guam 96910

or, alternate address

Coordinator, Graduate Program in Biology

University of Guam

Marine Laboratory

UOG Station, Mangilao, Guam 96913

Cable: "UnivGuam" Telex: 721 6275

UNIVERSITY OF HAWAII

Honolulu, Hawaii 96822

Hawaii's unique location in the Pacific Ocean makes it inevitable that a marine orientation will appear in some aspect of all man's activities in these islands. The University of Hawaii, recognizing this all-encompassing orientation, has structured its marine programs to insure that the students in all disciplines have an opportunity to share fully in the marine resources of the University and the State. Hawaii's natural setting, with beaches, coral reefs, and easy access to the open ocean, and its numerous marine-oriented organizations, combines with the university facilities to provide an unusual opportunity for marine studies.

No single department of the university has sole responsibility for marine curricula. There is a university-side focus on marine activities, with coordination through a Marine Council reporting to the Chancellor of the Manoa Campus. Marine interests involve the Departments of Botany, Zoology, Geology, Geophysics, Oceanography, Agriculture and Resource Economics, Architecture, History, Biochemistry and Biophysics, among others, in the College of Arts and Sciences. Other marine-related programs and curricula

can be found in the School of Law, the School of Medicine, the College of Engineering, and the College of Tropical Agriculture.

An undergraduate marine non-degree program, the Marine Option Program, offers students from any major field of study the opportunity to acquire a marine orientation during the pursuit of the associate or baccalaureate degree. Several marine-related research institutions function both on and off campus, including the Hawaii Institute of Geophysics, Pacific Biomedical Research Center, Look Laboratory of Ocean Engineering, Environmental Center, Water Resources Research Center, Hawaii Undersea Research Laboratory, and the Hawaii Natural Energy Institute. Although some departments have a greater marine orientation than others, there is no section of the university untouched by marine influences.

THE SEA GRANT COLLEGE PROGRAM: Hawaii's Sea Grant College Program is multidisciplinary and multi-focused and addresses a wide spectrum of concerns the state sees as immediate and vital to the well-being of its marine environment. Undergirding Sea Grant activities is the knowledge that Hawaii, because of its unique mid-ocean location, has access to vast resources which need to be studied and developed without harmful disruption of the marine ecosystem in which such resources are found. Marine research and development in Hawaii are, as yet, largely areas of discovery. As relevant and real needs within the state become identified, they will become concerns of the *Sea Grant College Program* at the University of Hawaii. Current Sea Grant activities encompass projects in marine resources, including aquaculture and fisheries; socio-economic and legal studies which have a particular focus on the Pacific basin; marine technology research and development; marine environmental research; and marine education and training.

The latter mission of the Sea Grant College Program provides support for the development of curricula at all appropriate levels within the university system. Courses have been developed in marine technician training, aquaculture, marine agronomy, ocean engineering, the humanities, and biology. Public education, conducted under the marine extension service arm of the Sea Grant College Program, serves both general needs as well as problem-solving needs of the state's marine constituency.

UNIVERSITY MARINE FACILITIES AND INSTITUTES:

SHIP OPERATIONS: The university operates two large oceanographic research vessels from the University Marine Center at Pier 45: *R/V Kana Keoki* (156 feet) and *R/V Moana Wave* (175 feet). A smaller vessel, *R/V NOII* (65 feet) is used to provide instruction in oceanographic research for undergraduate students of the university and community colleges and high school students, as well as for instrument testing.

WAIKIKI AQUARIUM: The Waikiki Aquarium is a state-owned museum specializing in Hawaiian aquatic exhibits. It is located in Waikiki and is operated by the

University of Hawaii as a place for the education and recreation of Hawaii's residents and visitors.

HAWAII UNDERSEA RESEARCH LABORATORY: The Hawaii Undersea Research Laboratory is located at the Makai Research Pier, Makapuu Point, Oahu, and is funded by the NOAA Undersea Research Program Office through the University of Hawaii's Marine Programs.

The Hawaii Undersea Research Laboratory (HURL) provides support personnel and facilities, including the university-owned submersible, *Makali'i* for marine research projects. The *Makali'i* is a two man, one atmosphere vehicle capable of diving to 1200 feet, equipped with black and white and color television, 35 mm still camera and strobe, CTD environmental monitoring instrument, manipulator and an array of sampling devices.

The Makai Research Pier, a privately owned facility built on state land is dedicated to supporting marine research programs and provides offices, warehouse space and wharfage for conducting a variety of marine related projects. The university-owned habitat *Aegir*, is presently deactivated, but is dedicated to the HURL program, and is also housed at the facility.

HAWAII INSTITUTE OF GEOPHYSICS (HIG): The HIG conducts geological, geochemical, and geophysical research in the broad field of the earth sciences. Programs embrace research and advanced training in geodesy, marine geology and geophysics, physical oceanography, solid earth geophysics, geology, geochemistry, underwater acoustics, and tsunamis. The Institute maintains a twin-engine PBY-type aircraft and a seismographic observatory.

HAWAII INSTITUTE OF MARINE BIOLOGY: The Hawaii Institute of Marine Biology, an administrative unit under Organized Research of the University of Hawaii, provides research facilities for use by faculty with research programs, graduate students with thesis research, visiting scientists, and inhouse research programs. It serves as a base for field trips for courses in marine sciences of the university. Research programs include studies in the ecology, physiology, behavior and systematics of marine animals and plants, freshwater and marine aquaculture, pollution studies, biology, chemistry, and pharmacology of toxic marine organisms, fundamental research in the interrelationship of organisms and their environment, and other varied research activities.

The Institute is about 17 miles from the University of Hawaii campus, situated on a small island (Coconut Island) in Kaneohe Bay. There are shop and maintenance facilities, a machine shop, a small dark room, a computer room with time sharing equipment, analytical services, stenographic services. There are two 40-foot diesel boats plus a number of 13-foot and 16-foot Boston Whalers.

The Institute does not grant degrees, but provides research facilities for graduate students of the University of Hawaii. In addition, the Institute offers an

intensive training and research summer course in selected topic areas for specially qualified graduate students from throughout the world.

To obtain further information, address inquiries to:
Director
Hawaii Institute of Marine Biology
P.O. Box 1346
Kaneohe, HI 96744

JAMES K.K. LOOK LABORATORY OF OCEANOGRAPHIC ENGINEERING: The J.K.K. Look Laboratory in the research facility of the Department of Ocean Engineering. Research is conducted on ocean engineering problems related to the coastal zone and the deep ocean. The laboratory serves both as a modelling facility and as a base for field work. Also located at Look Laboratory are facilities operated by the Department of Physiology for conducting hyperbaric research and treatment. Other laboratory facilities include: water wave channels; water wave basin for study of hydraulic models of coastal structures; basin for study of motion of ship models; and a wind tunnel.

The laboratory serves education through laboratory courses and student participation in its tasks and aids in the planning, analysis and design features of ocean-related physical problems occurring throughout the state.

HAWAII COOPERATIVE FISHERY RESEARCH UNIT: The Hawaii Cooperative Fishery Research Unit promotes graduate training and research in fishery biology by providing students with support, counseling, facilities, and opportunities to participate in Unit research projects. It functions academically as part of the Department of Zoology, and is linked administratively to the Hawaii Institute of Marine Biology. The research program centers of fishery biology and ecology of in-shore marine and inland waters. The Unit operates under joint sponsorship of the University of Hawaii, the Hawaii Department of Land and Natural Resources, and the U.S. Fish and Wildlife Service.

THE PACIFIC BIOMEDICAL RESEARCH CENTER: The Pacific Biomedical Research Center (PBRC), an administrative unit under Organized Research at the University of Hawaii at Manoa, provides research facilities for use by faculty with research programs, graduate students, visiting scientists and in-house research programs. The institute does not grant degrees but provides research facilities for registered graduate students of various departments of the University of Hawaii.

The PBRC program activities center around cell structure and function, regulatory biology and neurobiology, using marine invertebrate preparations as model systems. These programs are conducted in the Kewalo Marine Laboratory at Kewalo Basin and in the Bekesy Laboratory of Neurobiology on campus. These buildings provide space, research equipment and research facilities, including darkrooms, machine shops, electronic shops, electro-physiological equipment, electron microscopes and equipment for the presenta-

tion and control of auditory and visual stimuli and automatic programming of behavioral experiments. The research faculty represent several disciplines in both of these major programs.

In addition, PBRC encourages investigations in the areas of reproductive biology, the assessment of the health hazards of pesticides and in newborn psychology and behavioral biology.

CENTER FOR ENGINEERING RESEARCH: The Center for Engineering Research encourages development of new engineering research programs in the College of Engineering and provides technical and administrative support to existing projects. The center provides complete services for preparation of proposals and research reports. It participates in the planning, support services and operation of conferences, symposia and workshops. It keeps up-to-date records of all proposals and active research grants and contracts.

The center activities include research in structural engineering, transportation engineering, earthquake engineering, water resources, waste water treatment and disposal, geothermal energy, ocean thermal energy, fuels from biomass, wind energy, solar energy, theoretical mechanics, heat and mass transfer, materials science, coastal engineering, ocean structures, robotics, computer-aided design, bio-engineering, information theory, solid state devices, multi-processor computers and ionospheric dynamics. The center has one full-time researcher and one visiting colleague, but all projects come from the college faculty. The Center for Engineering Research is simply the research arm of the college.

To obtain further information, address inquiries to:
Dean of the College of Engineering
Center for Engineering Research
2540 Dole Street,
Honolulu, HI 96822
(808) 948-8301

WATER RESOURCES RESEARCH CENTER: The Water Resources Research Center (WRRRC) plans and conducts research related to Hawaii's water resources, assists and promotes instruction in water resources in several academic departments, and provides for training opportunities of engineers and scientists through research. Research is interdisciplinary with a broad base of physical sciences, technology, ecology, and social sciences. It involves hydrology and hydraulic engineering and public health, climatology and soil physics, agricultural engineering and forestry, and socio-economic and legal aspects. The center operates research laboratories and field research facilities.

CURRICULUM RESEARCH AND DEVELOPMENT GROUP: The Curriculum Research and Development Group of the College of Education designs, develops, evaluates and disseminates curricular programs for elementary and secondary schools, primarily in Hawaii. Prototype instructional materials are classroom tested first at the University Laboratory School, also a part of the Curriculum Research Group, and then in cooperat-

ing public and private schools of Hawaii. Curricular programs typically undergo five to seven years of testing, evaluation and revision during which they are examined for pedagogical and subject matter validity. Curricular programs developed at the Curriculum Research and Development Group are disseminated through inservice teacher training workshops and institutes.

Of the more than twenty-five curricular programs developed here, three major programs and several smaller units were developed for elementary and secondary marine education. These include the one-year High School Marine Science Studies (HMSS) Program, the one-semester Coastal Problems and Resource Management Program, and the "Reef and Shore" Teacher Resource Unit of the elementary Hawaii Nature Studies Program. Other marine-related units have also been developed in English, multi-cultural education and other subject areas. Program-specific inservice teacher workshops are generally offered during the summer through the College of Continuing Education.

For further information, contact:

Director
Curriculum Research and Development Group
College of Education-University of Hawaii
1776 University Avenue
Honolulu, HI 96822
(808) 948-7863

UNDERGRADUATE PROGRAMS:

MARINE OPTION PROGRAM: *The Marine Option Program of the University of Hawaii, is a program for undergraduates in all majors who are interested in the marine and freshwater environments. Students who complete a core of marine-related courses and a hands-on marine skill project/internship may earn a certificate which complements their formal degree program. Past skills include underwater photography, dolphin language training, research cruises, aquaculture, Hawaiian canoe paddling, marsh archaeology, marine cookbooks, fisheries assessments, ecological baseline surveys, marketing surveys for the Wakiki Aquarium, electronics, underwater construction, computer modeling, beach erosion, diving physiology, and marine education. Enrollment is open year 'round and an experienced staff counsels students in marine curricula and careers.*

In addition to the formal certificate program, the Marine Option Program (MOP) sponsors various activities to bring together people who share a love for the oceans: a newsletter, film seminars, field trips, a marine art fair, picnics, diving workshops, an annual Ocean Fair, and a fishing derby. In addition, the MOP office serves as a home and resource center for students on campus.

MOP is available at seven campuses of the University of Hawaii system: University of Hawaii, Manoa, University of Hawaii, Hilo, Windward Community College, Leeward Community College, Honolulu Community College, Kauai Community College, and Maui Community College. The program is sponsored by the Uni-

versity of Hawaii, the Sea Grant College Program, and the State of Hawaii Ocean Resources Office. Numerous government agencies and private concerns from Hawaii's marine community participate by providing skill opportunities for MOP students.

To obtain further information, address inquiries to:

Director, Marine Option Program
University of Hawaii, Manoa
1000 Pope Road
Marine Science Building, Room 208
Honolulu, HI 96822
(808) 948-8433

BOTANY: Because the University of Hawaii is located in the tropics, its Botanical Sciences Program offers a unique opportunity for the study of tropical terrestrial and marine species in their environment. Hawaii also offers a unique ecological environment for the study of tropical plant diseases.

Special activities associated with the botanical sciences program are a Sea Grant program in marine agronomy, a Resources Studies Unit of the National Park Service, and a plant disease clinic. Ecology of marine algae and sea grasses, production ecology of marine plants and algal systematics are strong offerings of the department and have won international recognition. Among staff members are world leaders in marine plant aquaculture.

Special facilities at the university include the Hawaii Institute of Marine Biology for the study of marine algae and other marine plants.

Arrangements for study may also be made with respective directors of the Honolulu Botanical Garden; the Bernice P. Bishop Museum, which has extensive reference material and plant collections; the Pacific Tropical Botanical Garden; and the Hawaiian Sugar Planters' Association Experiment Station.

M.S. (Plan A/Thesis; Plan B/Non-thesis and **Ph.D.** degrees in the botanical sciences are offered. At the discretion of a candidate and his/her committee, the degree may have the subtitle: Botanical Sciences (Plant Pathology). The graduate field of Botanical Sciences combines the resources of the Departments of Botany and Plant Pathology to offer programs leading to M.S. and Ph.D. degrees.

1. The **M.S.** (Plan A) degree is intended for students pursuing research in botanical sciences as a profession and requires 12 credits for thesis work with a minimum of 18 additional credits for courses approved by the candidate's committee.

2. **M.S.** (Plan B) degree emphasizes the technological aspects of the botanical sciences and requires 30 credits, 15 of which must be in the major field or an approved related field in courses numbered 600 or above.

3. The **Ph.D.** degree in Botanical Sciences, besides other basic requirements, requires a dissertation which is to be an original contribution based on independent research.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman
Department of Botany
University of Hawaii
3190 Maile Way
Honolulu, HI 96822
(808) 948-8369

DEPARTMENT OF GEOLOGY AND GEOPHYSICS:

Research and study leading to the **M.S.** and the **Ph.D.** degrees in geology and geophysics are offered in general geology (for teaching, technical or economic careers), marine geology and geophysics, seismology, geodesy (including gravity), volcanology, petrology and geochemistry, experimental petrology, solid-state geophysics, planetary science and remote sensing, and hydrology and engineering geology. Because of the university's location on an island in the middle of the Pacific Ocean, the department and research institutes maintain an emphasis on topics related to the Pacific Basin and its islands and margin.

Incoming **M.S.** and **Ph.D.** candidates will have a preliminary conference with the Graduate Work Committee to guide them on first-semester course selection and appointment of an interim adviser. **M.S.** students later will take a general examination; **Ph.D.** candidates a qualifying examination. **M.S.** students are urged to complete a research thesis, with a final oral examination. Under guidance of an adviser, **Ph.D.** candidates complete a dissertation, with a final oral examination. A nonthesis option is available for students pursuing the **M.S.** degree.

Entrance to the department is made through application to the Graduate Division. All completed forms, transcripts, the application fee, and in the case of foreign students, TOEFL results, are due by February 1 for the Fall semester or September 1 for the Spring semester. GRE results and three letters of reference should be sent directly to the department. The department encourages applications not only from undergraduates and master's level students who have majored in the earth sciences, but also from those in physics, chemistry, biology, mathematics, and engineering.

The department is housed in the Hawaii Institute of Geophysics, an institute that conducts multidisciplinary research in marine, earth, and planetary sciences. Laboratory facilities are available for studies and/or data reduction in the fields of high pressure research; geochemistry, stable and radioactive isotope geology; X-ray, microprobe, and scanning electron microscopy analysis; mineralogy; petrography; micropaleontology; seismology and paleomagnetism; earthquake and marine reflection and refraction seismology; ocean bottom and downhole seismometer development; geomagnetism; gravity; bathymetry; high-precision laser ranging; satellite geodesy as well as spacecraft, telescope, and remote-sensing field observations; laboratory simulations; computer image and spectrum processing; and instrument development in planetary and

remote-sensing science. The Hawaii Institute of Geophysics operates the deep-sea research vessels *Kana Keoki* and *Moana Wave*, the coastal vessel *Noi'i*, and a ship operations facility at Snug Harbor in Honolulu. The institute maintains support machine and electronic shops, a library, core and rock storage, scientific data archives, a Harris-800 computer system, a duplicate of the shipboard computers, radio communications, and drafting, publications, and other facilities. The Water Resources Research Center conducts interdisciplinary research in hydrology of both a basic and practical nature related to Hawaii's water resources.

Teaching and research assistantships, available to qualified students, provide tuition waivers and stipends ranging from \$5,364 to \$8,900 per year.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman, Graduate Work Committee
Department of Geology and Geophysics
University of Hawaii
2525 Correa Road
Honolulu, HI 96822

METEOROLOGY: Intended candidates for the **M.S.** or **Ph.D.** degree must present a thorough preparation in general physics, chemistry, and mathematics through calculus, as well as a minimum of 14 hours of undergraduate credit in meteorology including courses in climatology, instruments and observations, descriptive meteorology, and synoptic meteorology. Deficiencies in undergraduate preparation must be made up. Besides meteorology courses, courses may be allowed in the fields of oceanography, physics, and mathematics.

1. **M.S.** A minimum of 24 credit hours of coursework and six credit hours of thesis research. General and thesis examinations are required.

2. **Ph.D.** A reading comprehension of one foreign language with useful scientific literature in the field of the candidate. At some time during his first year of residence, the **Ph.D.** candidate may be required to pass a screening examination prerequisite to proceed toward a degree.

OCEAN ENGINEERING: The Department of Ocean Engineering is a graduate department and offers the degrees of *Master of Science* and *Doctor of Philosophy in Ocean Engineering*. Undergraduates who are interested in ocean engineering are encouraged to pursue their studies in either civil or mechanical engineering, where programs of study emphasizing coastal or marine engineering are available. These programs may be self-contained or may serve as an excellent preparation for graduate studies. In addition, the Department of Ocean Engineering offers a number of senior level courses of an introductory nature.

For admission to the graduate program, applicants must have received a **B.S.** degree in engineering, or in a related science with engineering prerequisites, and have an adequate background in mathematics and physics.

The graduate program in ocean engineering is intended to channel the student's previous engineering experience to ocean-related work. Students may pursue their studies in either of two options: coastal engineering or offshore engineering. Departmental interests include: design of coastal and harbor structures, beach and surf parameters, nearshore and estuary hydrodynamics, hydraulic modeling, numerical modeling, analysis and design of fixed and floating structures, offshore ports, mooring systems, submersibles, semi-submersible platforms, ocean acoustics.

Career opportunities for graduates in ocean engineering exist in different areas. Depending on the student's individual interest, employment may be sought with industry, government or universities. Government positions are usually with the U.S. Army Corps of Engineers, or with state, city or county public works departments, and U.S. Naval Facilities Command. Jobs in private industries are with the large oil companies, consulting and contracting firms, environmental services firms or laboratories, offshore mining companies, and large systems design companies. Graduates with a Ph.D. degree in ocean engineering have found jobs in research-oriented positions with universities, government or private companies.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Chairman

Department of Ocean Engineering

University of Hawaii at Manoa

2540 Dole Street, Holmes Hall 402

Honolulu, HI 96822

(808) 948-7572

OCEANOGRAPHY: The university currently offers a **Master's** and a **Doctoral program** in physical, chemical, geological, and biological oceanography.

Intended candidates should have an undergraduate major in physics, chemistry, geology, geophysics, engineering, mathematics, biology, zoology, or botany. A minimum of one year of calculus, physics, and chemistry is required of all students prior to admittance. A minimum of one semester each of geology and biology are recommended as well. Graduate Record Examinations (advanced and aptitude) are required. Interested students should write to the department chairman for a brochure and further information.

Students pursuing a degree program must take a core curriculum and other background courses during the first year. Subsequently the student specializes, depending on his/her disciplinary inclination. A Departmental Oral Exam is administered to all students, usually at the end of the first year of study. At this time the student may be admitted directly into the Ph.D. program, or may be required to work initially toward the M.S. degree.

All students must demonstrate qualification in digital computing, must accumulate (or have accumulated) at least one month of field experience, and must take at least one graduate seminar course in oceanography.

The M.S. program requires a minimum total of 30 credit hours, including 18 credits of coursework and 12 credits of thesis research.

Candidates for the Ph.D. must pass a comprehensive examination and a final oral examination in defense of the dissertation. They must qualify in one foreign language.

ZOOLOGY: The zoology program is designed for students working for the **M.S.** and **Ph.D.** degrees. Because of our marine environment, strong programs have developed in many aspects of the biology of marine animals. Special competence is found in the areas of animal behavior, avian biology, comparative endocrinology, comparative physiology, developmental biology, evolutionary biology and systematics, ecology, ichthyology, invertebrate zoology and neurophysiology.

Intended candidates for the M.S. or Ph.D. degrees in zoology must present a minimum of 18 credits of undergraduate preparation in zoology and must have completed two years of chemistry (inorganic and organic), one year of physics and courses in calculus and botany. An official record of the student's performance on the GRE (aptitude and advanced in biology) must be submitted to the chairperson of the zoology program before any action will be taken on applications for admission. Application deadline is February 1.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Chairman

Department of Zoology

University of Hawaii

152 Edmondson Hall

2538 The Mall

Honolulu, HI 96822

UNIVERSITY OF HOUSTON

Houston, Texas 77004

Graduate students interested in Marine biology may participate in a program jointly administered by the University of Houston (UH) and the National Marine Fisheries Service (NMFS). Students take advanced courses at the UH Central Campus in Houston and conduct research in laboratories at the NMFS facility in Galveston, 45 miles south of Houston. A wide range of research expertise encompassing both applied and basic areas is available to participants.

MARINE SCIENCE PROGRAM FACILITIES AT GALVESTON: Graduate students have access to laboratories of UH and NMFS, as well as an estuarine area of 180 acres with wet laboratory managed by NMFS. The main laboratory facilities have a circulating seawater system, several wet laboratories, algal culture rooms, aquaculture raceways, and a hatchery. Research equipment available to UH students includes a transmission electron microscope, critical point drying apparatus, photomicroscope, ultra and refrigerated centri-

fuges, recording spectrophotometer, densitometer, scintillation counter, incubators, ultracold freezer, Coulter counter, electrophoresis equipment, IBM Copier II, and a field vehicle.

The following degrees are offered:

1. **M.S. in Biology** specializing in Marine Biology.
 - a) Enrollment in the Departmental Colloquium during the first semester
 - b) Biochemistry or statistics (one semester)
 - c) At least one of the following techniques courses: Biometrics, Radioisotopes, Electron Microscopy, Instrumental Biology, Ecological Methods, Genetics and Molecular Biology II, or Tissue Culture Techniques
 - d) Enrollment each year in one specialty seminar
 - e) Thirty credits including: six hours thesis, six hours in a minor field of study, and a minimum of two 6000 level, nonseminar courses
 - f) Candidacy Examination by 10th month
 - g) Presentation and defense of a Master's thesis.
 2. **Ph.D. in Biology** specializing in Marine Biology (Ph.D. students entering with a M.S. degree need complete only (a), (d) and (e) below)
 - a) Enrollment in the Departmental Colloquium during the first semester of enrollment
 - b) Biochemistry or statistics (one semester)
 - c) At least one of the following courses: Biometrics, Radioisotopes, Electron Microscopy, Instrumental Biology, Ecological Methods, Genetics and Molecular Biology II or Tissue Culture Techniques
 - d) Enrollment each year in one specialty seminar
 - e) A minimum of four 6000 level non-seminar courses. No other specific course hour requirement except as specified by committee
 - f) Qualifying Examination by 20th month
 - g) Presentation and defense of Ph.D. dissertation
- Curriculum offered: available in school catalog.
 Faculty appointments: available in school catalog.
 To obtain further information, address inquiries to:
 Director, Marine Science Program
 University of Houston
 4700 Avenue U
 Galveston, TX 77550

UNIVERSITY OF MAINE

Orono, Maine 04469

The University of Maine offers marine-related courses both at the Orono campus and the university marine station, the Ira C. Darling Center. The Orono campus provides classrooms, laboratories and courses which integrate field work with study. Although no undergraduate degree programs in marine science exist, the Center for Marine Studies at Orono suggests certain elective courses to enhance major curricula by providing an introduction to marine studies.

At the Darling Center, 100 miles south of Orono on the coast, facilities on a 136-acre site include classrooms and research laboratories, access terminal for the Orono computing equipment, library, year-round accommodations for students, two 34-foot research vessels and small craft, a deepwater pier and waterfront facilities. Open ocean research capability is provided by the UNOLS fleet and cooperative use of vessels at other institutions.

The Department of Oceanography, primarily located at the Darling Center, offers a program of study and research leading to the **M.S.** and **Ph.D.** Specific fields of research include planktology, benthic and polar ecology, aquaculture, marine fishes, phycology, pollution, micropaleontology, paleomagnetism, tectonics, petrology and chemistry. In addition to required core courses, candidates for the Ph.D. in Oceanography must present one major seminar a year, participate in regular oceanic cruises, demonstrate reading knowledge of two foreign languages and complete and defend a research dissertation.

Curriculum offered: available in school catalog.
 Faculty appointments: available in school catalog.
 To obtain further information, address inquiries to:
 Director
 Center for Marine Studies
 Coburn Hall
 University of Maine at Orono
 Orono, ME 04469

UNIVERSITY OF MARYLAND

College Park, Maryland 20742

MARINE - ESTUARINE - ENVIRONMENTAL SCIENCE PROGRAM: Students seeking a degree in Marine-Estuarine-Environmental Science, the principal program for marine science, or in marine concentrations in other programs have access to the extensive research facilities of the University's Center for Environmental and Estuarine Studies. The Center has complete laboratory facilities for research in marine sciences located on the Chesapeake Bay at the Horn Point Environmental Laboratory near Cambridge, Maryland, and at the Chesapeake Biological Laboratory at Solomons, Maryland. In addition to a Shellfish Aquaculture Research Laboratory and a Controlled Environment Laboratory at these facilities, students also have access to a fleet of laboratory-equipped research vessels and smaller craft, which are available for work on the Chesapeake Bay or other waters.

In addition, students will find their work greatly enhanced by the special ties most faculty maintain to the many government laboratories and agencies in the Washington-Baltimore area. Library resources, which include the Library of Congress and the National Agricultural Library, are among the best in the nation. The University also has an active Sea Grant research pro-

gram, with its main office located on the College Park Campus.

A University-wide program in Marine-Estuarine-Environmental Sciences (MEES) offers work leading to the **M.S.** (thesis option only) and **Ph.D.** degrees. Degree work may be pursued on a part-time basis. The program is interdisciplinary, and areas of specialization include marine and estuarine ecology, environmental biology, environmental chemistry, environmental microbiology, environmental toxicology, environmental management, marine and environmental technology, and fisheries and wildlife management.

Applicants are judged on the basis of their previous academic work and scores on the GRE Aptitude Test. Each student will work closely with an advisory committee, and the course of study will be tailored to the individual student's needs and goals.

The program includes a core curriculum of courses selected from three (for the M.S.), or four (for the Ph.D.), of the following areas: ecology and or physiology of plants or animals; biochemistry; ecology and/or physiology of microorganisms; physical, chemical, engineering, or geological sciences; and management (economics, resource development, systems analysis, or biology and management of various natural resources). Statistics is required of all degree candidates. Any prerequisites for courses may be met through coursework after the student is admitted to the graduate program.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director
MEES Program
0313 Symons Hall
University of Maryland
College Park, MD 20742

DEPARTMENT OF BOTANY: The Department of Botany offers **M.S.** and **Ph.D.** degrees with a specialty in marine botany. A full complement of courses is available for interested students. Students are urged to expand their training by summer study at the Marine Biological Laboratory at Woods Hole, Massachusetts.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman
Department of Botany
University of Maryland
College Park, MD 20742

DEPARTMENT OF MICROBIOLOGY: The Department of Microbiology, which offers the **M.S.** and **Ph.D.** degrees, also has a specialty in marine microbiology. Extensive research programs focus primarily on biochemical ecology, with emphasis on the following areas: fish and shellfish diseases; the survival and distribution of human pathogens through marine environments; deep ocean research; the role of bacteria in the breakdown of toxic chemical pollutants; and mineralization and nutrient cycling of marine life.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman
Department of Microbiology
University of Maryland
College Park, MD 20742

DEPARTMENT OF ZOOLOGY: The Department of Zoology offers the **M.S.** and **Ph.D.** degrees with specialization in estuarine and marine biology. Research interests of the faculty who instruct in this area include: the distributional ecology of stream benthic invertebrates; the morphology and behavior of elasmobranch fishes and marine teleost fishes of the Red Sea and western tropical and north Atlantic; the environmental physiology of marine invertebrates; the biology of estuarine and marine protozoa; biogeography; intertidal ecology; the developmental biology of marine invertebrates; and the reproductive strategies and evolutionary dynamics of marine host-parasite systems. Students have access to research facilities of the Center for Environmental and Estuarine Studies on the Chesapeake Bay, but they are encouraged to spend at least one summer at a marine biological laboratory outside the Bay for broader experience with marine environments.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman
Department of Zoology
University of Maryland
College Park, MD 20742

Other programs at the University of Maryland, College Park, which offer coursework in various areas of marine science include Agricultural and Resource Economics, Agricultural (and Aquacultural) Engineering, Civil Engineering, and Mechanical Engineering.
To obtain further information, address inquiries to:
Graduate School
South Administration Building
University of Maryland
College Park, MD 20742

UNIVERSITY OF MASSACHUSETTS Amherst, Massachusetts 01003

The University of Massachusetts Marine Station, an interdisciplinary research facility operated by the Graduate School, is located on the coast of Gloucester approximately 35 miles north of Boston. Deepwater mooring is provided for research vessels. The station is equipped for a wide range of marine biochemical, biological, and chemical studies in laboratories with modern research equipment, cultural facilities, seawater systems, machine shop, and small library. Both basic and applied research is conducted by faculty and graduate students from the Amherst campus.

Short-term living accommodations are available in Gloucester for several students and researchers.

The Departments of Botany, Civil Engineering, Food Science and Nutrition, Geology Geography, Wildlife and Fisheries Biology, and Zoology all offer courses related to marine science.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Dean of Graduate Studies and Research

University of Massachusetts

Amherst, MA 01003

THE UNIVERSITY OF MIAMI ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE

Miami, Florida 33149

The Rosenstiel School of Marine and Atmospheric Science was established in 1943 as the Marine Laboratory of the University of Miami. A program of studies leading to the Master of Science degree was initiated in 1949. In 1953, laboratory and classroom buildings were constructed on the School's present campus on Virginia Key, and in the late fifties, the Marine Laboratory expanded its staff and developed its oceanographic capabilities in response to the increased interest in scientific research in the United States.

Today, the Rosenstiel School has a faculty of 70 scientists who conduct sponsored research while offering studies leading to the Master of Arts, Master of Science and Doctor of Philosophy degrees. With the University's College of Arts and Sciences, undergraduate programs leading to the Bachelor of Science and Bachelor of Arts degrees are offered.

Facilities include the Gilbert H. Grosvenor Laboratory which houses modern scientific equipment for radiation detection, optical spectroscopy, atomic absorption, electron microscopy, chromatography, and spectrometry. Also located here are catalogued biological research collections. The Alfred C. Glassell Jr. Laboratory has circulating seawater aquaria throughout and is used for biological research on marine animals ranging from plankton to sharks. Within its walls, it is possible to reproduce and maintain natural or artificial marine environments controllable in such parameters as temperature, salinity, turbidity and pH.

The unique Tritium Laboratory is equipped for the global monitoring of tritium, a radioactive isotope important as a tracer in the environment. The Cooperative Institute for Marine and Atmospheric Studies is intended to serve as a focal point for concentrated research on specific problems of the ocean and atmosphere by specialist from the Rosenstiel School and the National Oceanic and Atmospheric Administration, and to strengthen local research activities with the added expertise of visiting scientists from the United States and around the world.

The Rosenstiel School of Marine and Atmospheric Science (RSMAS) Library includes a collection of more than 35,000 volumes covering all fields of marine science. Over 1,000 current journal titles are regularly received as well as reports from state, federal and international agencies. In addition, there are 26,000 catalogued reprints, more than 2,100 microforms, and special collections of atlases, expedition reports, and rare books. The Library also offers computerized retrieval services.

The Computing Facility provides computing support to RSMAS faculty, students, and staff. It functions as a remote job-entry terminal to the University's UNIVAC system. It also accesses the computers of the National Center for Atmospheric Research in Boulder, Colorado, as well as providing stand-alone computing support.

In cooperation with the National Science Foundation's University National Oceanographic Laboratory System (UNOLS), the Rosenstiel School maintains a fleet of research vessels: *Columbus Iselin*, 170 feet; *Cape Florida*, 135 feet; *Calanus*, 62 feet; and *Orca III*, 45 feet.

The following degrees are offered:

1. The **M.S.** degree is offered with a major in biology and living resources, marine and atmospheric chemistry, marine geology and geophysics, meteorology and physical oceanography, and applied marine science. Twenty-four graduate course credits and six credits hours of thesis research resulting in a thesis *representing original research are required*. A comprehensive examination covering general information in the major field, as well as courses taken, is administered to all students. An examination demonstrating a reading knowledge of a foreign language may also be required.

2. The **M.A.** degree program is an interdisciplinary program which offers broad advanced training in the marine sciences applicable to the varied uses of the coastal zone and the development of marine resources. The program will be beneficial to students who do not intend to pursue a career in science, but who have interests in the areas of administration, management, and conservation of marine resources. Twenty-four graduate course credits and a six credit internship or research paper are required. A comprehensive examination must be passed upon completion of all course work.

3. The **P.h.D.** degree is offered with a major in biology and living resources, marine and atmospheric chemistry, marine geology and geophysics, meteorology and physical oceanography, and applied marine science. Thirty-six graduate course credits and twenty-four credit hours of dissertation research resulting in a dissertation representing original research are required. A written qualifying examination is required of all students admitted to the doctoral program. An examination demonstrating a reading knowledge of a foreign language may also be required.

4. The Certificate Program is offered in the areas of biology and living resources, and meteorology and physical oceanography. Admission to this program is restricted to international students who want training in a specific research area but who do not require an advanced degree. Students take graduate courses and may engage in a research project.

5. Undergraduate degree programs offered jointly with the College of Arts and Sciences include the *Bachelor of Arts* degree in marine affairs, and the *Bachelor of Science* degree in marine science/biology, marine science chemistry, marine science geology, and marine science physics. These programs are designed for the students who wish to pursue scientific or technical careers in oceanography. Each of these majors requires 130-140 credits. A full major in one of the basic sciences is included with a major in Marine Science. The student therefore earns a double major and acquires a preparation for scientific and technical work with industry or government agencies concerned with the ocean, as well as a preparation for graduate study.

The University also offers a Bachelor of Arts degree with a major in Marine Affairs to students interested in the commercial, legal, industrial, and economic aspects of the development and use of ocean resources. Marine Affairs students may select either pre-legal or business programs of studies, or may combine a major in Marine Affairs with minors such as Communication, Geography, Economics, or Politics and Public Affairs to prepare themselves for their careers.

Financial aid is available to qualified students on the basis of need through grants, loans and on-campus employment. The University of Miami also annually awards a number of scholarships to superior students regardless of financial need.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquires to:
Graduate Studies Office

Rosenstiel School of Marine and
Atmospheric Science

4600 Rickenbacker Causeway
Miami, FL 33149

(305) 350-7356

or,

Undergraduate Marine Science Program

University of Miami

182 Science Building

Coral Gables, FL 33124

(305) 284-2180

THE UNIVERSITY OF MICHIGAN

Ann Arbor, Michigan 48109

Marine and related programs at The University of Michigan are spread across a number of departments and interdisciplinary programs. One focus of marine-related activity is the Great Lakes and Marine Waters

Center (GLMWC) established in 1974 to coordinate Great Lakes research programs. The GLMWC operates the university research vessels and many of the faculty teaching in the marine curricula participate in GLMWC research activities.

At present, more than 150 scientists and staff carry on research in areas of impacts of thermoelectric power plants on aquatic systems, the fate and impact of toxic substances, the relationship of nutrients cycling and loading on productivity, eutrophication processes, the design of monitoring programs, coastal processes, and sedimentary environment.

The University of Michigan provides the Great Lakes and Marine Waters Center with approximately 25,000 square feet of laboratories and offices. This space is divided among the three component groups of GLMWC: the Great Lakes Research Division; the Michigan Sea Grant Program; and the International Program.

Included in the facilities are well equipped laboratories for benthos, plankton, zooplankton, chemistry, and fish studies, which include a scanning electron microscope facility. The usual laboratory equipment is available, and in addition we operate four auto-analyzers, an oscilloscope particle data counter, neutron activation equipment, and a computerized combined gas chromatograph-mass spectrometer. We have online computer equipment for laboratory and field use.

The Great Lakes and Marine Waters Center owns and operates a number of well-equipped research vessels, including: the *R/V Laurentian*, 80-foot steel hull; the *R/V Mysis*, 50-foot steel hull; the *R/V Coastal Spirit*, 20-foot fiberglass hull and the *R/V Outrage*, 21-foot fiberglass hull.

The University of Michigan has operated ships on the Great Lakes since 1957 and has an extensive record of lakes-related cooperative ventures with other institutions in the region. The *Laurentian* and the *Mysis*, are available as a regional resource to help meet the needs of academic scientists requiring capable mobile platforms for research on the Great Lakes.

The *Laurentian*, completed in 1974, is an 80-foot vessel with accommodations for a scientific party of 10 in single, double, and four-person rooms. This ship has two permanent laboratories (a 144 square foot below decks lab) and can accommodate portable laboratories or large-self-contained instrument packages on deck. It is capable of undertaking cruises of up to ten days duration and ranges of 2,500 miles and is ice-strengthened for winter operations.

The *Mysis*, built in 1963, is a 50-foot vessel with accommodations for three scientists in common quarters. It is capable of cruises of three and one-half days duration and ranges of 800 miles. It has a single deckhouse lab of 75 square feet of clear deck space.

Besides the facilities specific to each department, the University of Michigan offers all the advantages of a major university. An Amdahl research computer along with the Michigan Terminal System (MTS) operating system, and local software libraries provide out-

standing computing capabilities. The library system includes over four million volumes and 350,000 periodicals. Special collections like the Engineering-Transportation Library of 300,000 volumes and the Natural Resources Library and Great Lakes Research Division collection meet special needs of students in marine fields.

Also the university has a number of sites for research and field experience, including Camp Filibert Roth, in the western Upper Peninsula and the Biological Station in Cheboygan County with 9,000 acres and five miles of frontage on Douglas Lake.

The University maintains relationships with federal and state agencies with facilities in Ann Arbor including the Michigan DNR Institute of Fisheries Research, the Great Lakes Fisheries Laboratory of the U.S. Fish and Wildlife Service, the NOAA Great Lakes Environmental Research Laboratory, the Great Lakes Commission, and the Great Lakes Fishery Commission.

ATMOSPHERIC AND OCEANIC SCIENCE: The Department of Atmospheric and Oceanic Science is part of the College of Engineering and has laboratories for atmospheric and marine chemistry, synoptic meteorology, geophysical fluid dynamics, meteorological instrumentation, upper atmosphere studies, and facilities for general physical oceanography and marine geology. In addition, the Space Physics Research Laboratory is a part of this department.

Research activities of the faculty members and students in oceanography includes; air-water interfacial phenomena, circulation and diffusion processes, sediments and sedimentation processes, geology of the Great Lakes basins, marine mineral exploration, biogeochemistry of sediments, coral reef ecology, ecology of plankton and benthic communities, and coastal circulation processes. Recent studies have been conducted in the Great Lakes region, the Caribbean, the Gulf of Alaska, the Atlantic coast, and the central Pacific. Members of the Department also participate in the Deep-Sea Drilling Project. An active program in underwater operations is aimed at developing undersea capabilities.

Oceanography staff of the Department participate in the Michigan Sea Grant Program and in cooperative research with scientists from the NOAA Great Lakes Environmental Research Laboratory.

The following degrees are offered:

1. B.S. in Atmospheric and Oceanic Science. The undergraduate program in oceanic science prepares the student for a career in science. The first year of the program consists of mathematics, physics, chemistry, computer and humanities courses taken in common by all beginning students in the College of Engineering. Students begin to specialize in oceanic science in their second year of study while continuing to complete their foundation in mathematics and science. All students are required to have calculus through introductory differential equations, one year each of chemistry and physics, one term each of biology and

geology, four terms of oceanography, and humanities courses.

Beyond the common requirements of the oceanic science specialization in Atmospheric and Oceanic Science, most students elect to concentrate their science preparation towards one of the major sub-disciplines of oceanography: biological, chemical, geological, or physical. Such concentration coursework constitutes most of the last two years of the undergraduate program. In addition to the advanced science courses in one of these areas, students are expected to take at least one of the several advanced oceanography courses that are offered in each of the four subdisciplines. In addition, field and laboratory experience is available to those students who wish to participate in the various research projects of members of the oceanic science faculty.

A total of 128 credit hours of coursework is required of undergraduate students. The distribution of the courses making up this total is determined by the specific needs and interests of each individual, with the close supervision of a faculty counselor. The undergraduate program in oceanic science has considerable flexibility in course selection while retaining high academic integrity.

2. M.S. in Oceanic Science. An applicant for the M.S. degree in oceanic science is expected to hold a bachelor's degree and to have completed requirements in mathematics and physics. The bachelor's degree may be in any field of specialization, but students without undergraduate courses in oceanic science may be required to make up for this deficiency by completing undergraduate courses specified by their advisor.

Requirements for the degree include 30 credit hours of graduate studies approved by one of the graduate advisors, consisting of a minimum of at least 15 credit hours of coursework in oceanic science and a minimum of six credit hours of mathematics or three hours of mathematics and three hours of cognitive science.

The student's program will be adjusted to assure that the student obtains some proficiency in each of several core subject matter areas. For oceanic science, these core areas are physical and dynamical oceanography, oceanographic observations and data analysis, marine chemistry and marine geology. A thesis based upon original research is a normal part of the master's program.

3. Ph.D. in Oceanic Science. Applicants for the degree of Doctor of Philosophy in oceanic science are expected to have ability and scholarship of a high order. Students must be able to satisfy core requirements specified for the master's degree at a high level of competence and will elect additional courses to supplement their backgrounds and provide knowledge and techniques needed for carrying out independent investigations.

To satisfy the departmental requirements for doctoral candidacy, students must successfully pass a preliminary examination. When the student has become a candidate, a dissertation committee will be appointed by

the department chairperson. The subject of the dissertation may be in any area of oceanic science that is approved by the dissertation committee. A satisfactory oral examination of the candidate on the dissertation and related material, conducted by the dissertation committee, completes the requirements for the degree.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman
Department of Atmospheric and Oceanic Science
2233 Space Research Building
The University of Michigan
Ann Arbor, MI 48109

NAVAL ARCHITECTURE AND MARINE ENGINEERING: The department operates two model-testing facilities which are available for student projects at all levels. A well-equipped shop and staff are maintained. The towing tank is 360 feet long, with a cross-section of 22 feet by 10 feet. It is equipped with a carriage, a wavemaker, a beach, and a false bottom for shallow-water tests. The maneuvering basin is 60 feet by 100 feet by 6 feet. Wave makers are installed on one of the 60-foot sides, a beach on the opposite side, and a 14-foot wide towing carriage is also fitted along the adjacent wall. Equipment for radio control of models and telemetering is available.

The following degrees are offered:

1. **Bachelor of Science in Engineering** (Naval Architecture and Marine Engineering). Candidates for the degree of Bachelor of Engineering (Naval Architecture and Marine Engineering) must complete 55 hours of general required core courses, 3 hours of advanced mathematics, 22 hours of related technical subjects, 31 hours of program subjects, 14 hours of technical electives, and 11 hours of suggested and free electives.

2. **M.S. and M.S.E. in Naval Architecture and Marine Engineering.** The applicant should have a bachelor's degree (or equivalent education) in engineering, physics or mathematics. Preparation should include introductory courses in differential equations, solid mechanics fluid mechanics and dynamics. Some experience with a large digital computer is desirable.

The 30 credit hours required for the degree will normally include at least 15 hours in naval architecture and marine engineering beyond those required for the bachelor's degree, as well as five or more hours of graduate-level mathematics courses.

There are no specific courses required of all students at this level. Most students will specialize in one or more of the following areas, including in their programs, the basic courses specified: ship hydrodynamics, ship structures, marine engineering, ocean engineering, or marine systems.

The programs leading to the M.S.E. degree are intended to train students for careers in design, shipyard practice and management. Applicants for these programs should have obtained the B.S.E. degree in naval architecture and marine engineering, or they should have some experience in the marine field in

addition to a bachelor's degree in some other field than that of engineering. The M.S.E. degree is logically followed by one of the professional degrees. Students anticipating careers in research, development, and teaching will normally work for the M.S. degree, which may then be followed by the Ph.D. degree.

The graduate advisor may allow certain courses in other departments to be used in partial fulfillment of the requirement of 15 hours in naval architecture and Marine engineering, depending upon the background and goals of the individual student. The program in Marine Systems, Operations and Design is normally open only to applicants with a bachelor's degree or equivalent experience in the marine field.

3. **Naval Architect, Marine Engineer** (professional degrees). The professional degree program requires a minimum of 30 credit hours of work beyond the M.S.E. level or its equivalent, taken at this university with a grade average of B or better. Successful completion of a qualifying examination for admission to candidacy is required.

The total graduate program shall include: at least 24 hours in the area of the department or program cited in the degree. The department or program advisors may satisfy these hours in greater detail. At least six hours devoted to a research, designed or development problem, including a written report covering the work. A committee of faculty members will supervise the work, approve the report and conduct a final oral examination on this work. At least three courses in cognate fields other than mathematics are required, and at least nine hours in mathematics beyond the B.S.E. mathematics requirements of the department cited in the degree.

4. **Ph.D.** The Ph.D degree is conferred in recognition of marked ability and scholarship in some relatively broad field of knowledge. A part of the work consists of regularly announced graduate courses of instruction in the chosen field and in such cognate subjects as may be required by the student's committee. In addition, students must pursue independent investigations in some subdivision of the selected field and must present the results of their investigations in the form of a dissertation.

Students become applicants for the doctorate when they have been admitted to the Horace H. Rackham School of Graduate Studies and have been accepted in the field of specialization. No assurance is given that they become candidates for the doctorate until they have given evidence of superior scholarship and ability as original investigators.

There is no general course or credit requirement for the Ph.D. degree. Students must pass a comprehensive examination in their major field or specialization which tests their knowledge in that field and in the supporting fields before they will be recommended for candidacy for the doctorate. A special doctoral committee is appointed for each applicant to supervise the work of the student both as to election of courses and in preparation of the dissertation. A

pamphlet that describes the general procedure leading to the doctorate can be obtained from the Graduate School office upon request, and another for this department, specifically, is also available.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Chairman

Department of Naval Architecture and Marine
Engineering

N.A.M.E. Building, North Campus

The University of Michigan

Ann Arbor, MI 48109

SCHOOL OF NATURAL RESOURCES: (Highlighting specializations in fisheries and aquatic ecology.) The School of Natural Resources is located in the Samuel Trask Dana Building which offers 47,000 square feet of classrooms, laboratories and offices centrally located near the University General Library and the Natural Science Building.

Many natural resources courses are taught at the University of Michigan Biological Station or at Camp Filibert Roth.

Since professional employment in natural resource fields usually requires preparation beyond the bachelor's degree, the School of Natural Resources offers a basic curriculum that provides necessary background for further study in marine sciences, or fishery science, or aquatic ecology as well as offering master's and doctorate programs in natural resource areas.

The following degrees are offered:

1. **Bachelor of Science in Natural Resources.** The School of Natural Resources has prepared suggested study programs for students on the undergraduate level who wish to pursue an interest in marine sciences, including biological oceanography or marine biology or ecology; fisheries science; and natural resource ecology, including aquatic systems and biological oceanography.

2. **Master of Science in Natural Resources.** Master's students in Natural Resources normally affiliate with one of five programmatic areas: Environmental Educational and Outdoor Recreation; Fisheries, Forestry, and Wildlife; Landscape Architecture; Resource Ecology; or Resource Policy and Management. Opportunities to develop master's level programs which combine components of two or more program areas are available. Degree requirements are flexible and permit selection of courses to meet individual needs.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Dean

School of Natural Resources

University of Michigan

Ann Arbor, MI 48109

FISHERIES, FORESTRY AND WILDLIFE MANAGEMENT: Master's students concentrate or have options in one or a combination of many specializations within the disciplines of fisheries, forestry, or wild-

life management. The course of study is planned to meet the needs of the individual. Specializations might include: aquaculture, international resources management, management of recreation areas and fisheries, marine fishery development, natural resource biometry, water quality management, water-fowl management, watershed management and others.

Upon entering these areas of concentration, students will be expected to have a basic competence and balanced background in the biology-ecology, sociology, economic, quantification-inventory, and managerial concepts of renewable resources areas. This level of knowledge can be obtained by taking the recommended undergraduate program in one of these areas.

The graduate programs in fisheries are flexible enough to meet individual needs. The specific courses to be taken are chosen by the student in consultation with his or her advisor, and must be approved by the chairperson of the Fisheries-Forestry and Wildlife Program. A committee of at least two faculty members directs the student's program.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Chairperson

Fisheries, Forestry and Wildlife Program

University of Michigan

Ann Arbor, MI 48109

RESOURCE ECOLOGY: Coursework in the program consists of distribution requirements to assure breadth in important areas of ecology and courses to provide training in a special area of interest to develop appropriate analytical techniques or to provide further work in basic biological or physical science.

Each student must complete graduate or senior-level courses in four of the following five areas: systems ecology, animal ecology, plant ecology, physiological ecology, or aquatic ecology.

At the beginning of the student's graduate study program (specifically the proportion of credit hours in the distribution requirements above) must be defined in consultation with the faculty advisor and be approved by the Resource Ecology Program chairperson.

A committee consisting of at least two faculty members directs the student's program. The chairperson of the master's committee is ordinarily the student's major advisor and is the faculty member under whom the student wishes to concentrate his or her work. The other member or members are chosen to give a balanced and logical representation of interests involved in the program.

DOCTORAL PROGRAMS: The Doctor of Philosophy degree is awarded by the Horace H. Rackham School of Graduate Studies and may be earned for programs specializing in several areas of natural resources. A student may embark upon a doctoral program whether or not he or she has a professional degree in any natural resources field, but evidence must be given

of adequate preparation in the proposed field of specialization.

Students in Natural Resources are normally expected to have completed requirements for the master's degree before admission to a doctoral program. Entering students with the B.S. degree who wish to obtain the Ph.D. are usually first admitted to a master's program which is tailored to prepare them for later doctoral work.

Evaluation of an applicant for the Doctor of Philosophy degree is normally based upon graduate academic performance, broad comprehension of the subject, and potential as an independent investigator. No applicant is accepted until a faculty member agrees to act as that student's major advisor. The major advisor serves as chairman of the student's candidacy committee that guides course selection and conducts the preliminary examinations. The candidacy committee is appointed by the Graduate Affairs Committee of the School of Natural Resources.

All doctoral students must elect, as graduate students, at least two graduate-level cognate courses that carry two or more credits each and have been approved by a graduate advisor. Cognate courses taken as a master's degree candidate may, with approval, satisfy the doctoral degree requirement.

After a student has completed the course requirements established by the candidacy committee, a preliminary examination is administered by the committee. After passing this examination, the student becomes a candidate for the doctorate and is eligible to proceed according to the rules stated in the *Handbook for Doctoral Candidates*, Horace H. Rackham School of Graduate Studies. All doctoral degrees require the completion of a dissertation in a format acceptable to the student's dissertation committee and the Dean of the Rackham Graduate School. The dissertation must be defended successfully in a comprehensive oral examination before the dissertation committee.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Admissions Office
Horace H. Rackham School of Graduate Studies
The University of Michigan
Ann Arbor, MI 48109

INTERDISCIPLINARY PROGRAMS:

MARINE AND LACUSTRINE GEOLOGY: A master's degree in Marine and Lacustrine Geology is offered through a cooperative arrangement between the Department of Atmospheric and Oceanic Science and the Department of Geology and Mineralogy. Applications for submission may be made through either department and will be considered from students with undergraduate degrees in the earth or physical sciences, oceanography, or engineering. Students admitted to the program will ordinarily concentrate in one of three areas: Marine Sedimentation, Marine Geophysics, or Marine Geochemistry. A minimum number of 32 credit hours and a thesis are required. A

maximum of six hours in thesis research may be applied toward the total of 32 hours, and two required courses are common to the three options. Other requirements are specified for each option.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman, Department of Geology and Mineralogy
1006 C. C. Little Building
University of Michigan
Ann Arbor, MI 48109

or,
Chairman, Atmospheric and Oceanic Science
Space Research Building
University of Michigan
Ann Arbor, MI 48109

WATER RESOURCES PROGRAM: Program emphasis is placed on development of both technologic and socio-economic concepts required for solution of a variety of environmental and water resources problems. The Water Resources Program coordinates four basic graduate programs; Water Resources Engineering, Water Resources Management, Water Resources Science, and Health Aspects of Water Quality. All four draw upon the educational facilities of the College of Engineering, School of Natural Resources, School of Public Health, Law School, and College of Literature, Science and the Arts.

The program leading to the degree **M.S.E. in Civil Engineering, Water Resources** is open to qualified candidates with a Bachelor of Science degree in any of the generally recognized fields of engineering. Program emphasis is placed on development of both technological and socio-economic concepts required for solution of a variety of environmental and water resources problems. Candidates for the degree M.S.E. must complete a minimum of 30 hours of graduate work, planned in consultation with the program advisor, constituting an integrated program. A typical program normally includes courses in: hydrology and water quality management; water quality and water pollution control; water and wastewater treatment, water chemistry and limnology; air pollution and solid wastes control; systems analysis, operations research techniques, and computer applications; political and institutional factors in environmental and water resource systems.

The **Master of Science** program in **Water Resources Management** provides the student with a working knowledge of problems and approaches for managing the use and development of water resources and provides specialization in one of the major aspects of water management through integrated training in technical, economic, social, and institutional aspects involved in public water management enterprises. It is designed for individuals seeking careers in governmental and quasi-public agencies concerned with water resources planning and development.

The **Master of Science** program in **Water Resources Science** prepares the student in the fundamentals of

scientific investigation of natural and polluted waters, emphasizing studies in the chemical and biological sciences and including cognate courses designed to broaden the student's perspective of the total water resources field. The program is intended for those seeking positions in research and pollution control laboratories — whether in industry or in federal, state or local government.

All students are assured personal counseling to help them select the program that will best meet their individual interests. Students considering graduate study in water resources should consult as early as possible with members of the Interdepartmental Program Committee on Water Resources.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman, Water Resources Program
Engineering Building 1-A
The University of Michigan
Ann Arbor, MI 48109

UNIVERSITY OF MINNESOTA

Minneapolis, Minnesota 55455

The University of Minnesota offers marine science related courses on the Twin Cities and Duluth Campuses and at the Itasca Biology Station. Courses are offered in a number of departments.

To obtain further information, address inquiries to:
Marine Education Agent
Sea Grant Extension Program
109 Washburn Hall
University of Minnesota-Duluth
Duluth, MN 55812
The Fisheries Program is located on the St. Paul

Campus in the Department of Entomology, Fisheries and Wildlife.

The following degrees are offered:

1. **B. S. in Fisheries** (190 credits, minimum)
2. **M.S. in Fisheries**
 - a) Thesis plan — 28 credits minimum, plus thesis
 - b) Non-thesis plan — 44 credit minimum, plus research papers
3. **Ph.D. in Fisheries**
 - a) No credit minimum
 - b) Nine quarters registration
 - c) Thesis
 - d) Preliminary and final examinations

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director of Graduate Studies in Fisheries
219 Hodson Hall
1980 Folwell Avenue
St. Paul, MN 55108

UNIVERSITY OF MISSISSIPPI

University, Mississippi 38677

The University of Mississippi has research and teaching facilities in fresh water and marine sciences on the main campus at University. Selected classes are also taught at the Tupelo branch campus and the Universities Center in Jackson. Marine research is conducted by University scientists and the University is also affiliated with Mississippi's Gulf Coast Research Laboratory located at Ocean Springs, Mississippi. At the main campus facilities available consist of classrooms, offices, laboratories, and computers.

The University is part of the Mississippi-Alabama Sea Grant Consortium. It is this affiliation which provides the major emphasis for the present involvement of the University in marine science programs.

The following degrees or marine science related options are offered:

1. **Bachelor of Science in Geological Engineering**, marine geology option requires 135 semester hours.
2. **Bachelor of Arts in Biology or Geology**, or **Bachelor of Science in Biology** requires 126 semester hours.
3. **Master of Science in Geology** (School of Engineering) requires 30 hours of graduate credit, of which six will be thesis credits.
4. **Master of Science in Geology** (College of Liberal Arts) requires 30 hours of graduate credit, of which six will be thesis credits.
5. **Doctor of Philosophy**: Coursework requirements vary, one foreign language and a dissertation are required.
6. **Master of Marine Law and Science** (School of Law) requires 30 hours of graduate credits, of which 9-12 will be in specified marine related science. Prerequisites include a Bachelor of Science in one of the sciences plus a first degree in law.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Associate Director of University Research
University of Mississippi
University, MS 38677

UNIVERSITY OF NEW ENGLAND

SAINT FRANCIS COLLEGE

Biddeford, Maine 04005

Saint Francis College, the undergraduate college of the University of New England, offers four-year degree programs in Marine Biology and Environmental Analysis through its Center for Life Sciences. The 150-acre campus is located on the Saco River estuary on the coast of southern Maine. The programs utilize this loca-

tion for intensive study of estuarine, open sea, salt marsh, mud flat, rocky and sandy beach environments. These environments provide habitat for a wide variety of plants, invertebrates, fish, birds and other marine organisms, for individual as well as class study.

Laboratory space of 2,500 square feet includes four preparation laboratories, seven teaching laboratories, numerous office and storage rooms; equipment consists of electrophoresis units, environmental sampling devices, dredges, salinometer, bathythermograph, spectrophotometer, pH meters, a gas chromatograph, an otter trawl, seines and other types of fishing nets and gear; plankton nets; a temperature controlled tank room; and an aquarium room. In addition, a wide variety of bacteriological and chemical laboratory equipment and facilities exist along with the usual microscopes, refrigerators, and freezers.

The College maintains its own research vessel, 26-foot converted lobster boat, the *Sawowcotuck*.

Since our size and location do not permit an extensive research program, we encourage our students to gain experience, often along with academic credit by off-campus research placements. Those may be done through our Cooperative Education programs or during January Winter term, internships or summer jobs.

Cooperative arrangements have been made in past years with students working with the Maine Department of Marine Resources, West Boothbay Harbor; Maine Department of Environmental Protection, Augusta; The Research Institute of the Gulf of Maine, Portland, Maine; Maine Department of Inland Fisheries and Wildlife; National Marine Fisheries Laboratories at Sandy Hook, New Jersey, Panama City, Florida, Milford, Connecticut, Beaufort, North Carolina; United States Environmental Protection Agency, Narragansett, Rhode Island; New England Aquarium, Boston, Massachusetts; Mystic Marine Life Aquarium, Mystic Connecticut; American Museum of Natural History, New York City.

The University of New England, St. Francis College offers a *Bachelor of Science in Marine Biology* degree. In addition to required core courses, the student must choose one to three upper level biology courses in consultation with an academic advisor. Other college requirements in Liberal Learning, Human Services and Managerial Studies must also be completed to qualify for the degree.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director, Center for Life Sciences
University of New England
Saint Francis College
605 Pool Road
Biddeford, ME 04005
(207) 282-1515 x15

UNIVERSITY OF NEW HAMPSHIRE

Durham, New Hampshire 03824

Near a variety of marine environments, the University of New Hampshire is well-located for marine science and ocean engineering activities. The Great Bay estuarine system is adjacent to the campus while the coastline of the Atlantic is 15 miles away with the Isles of Shoals but a few miles offshore. The port city of New Hampshire, Portsmouth, is centrally located on the Gulf of Maine about 10 miles from the University.

The University's major marine facilities include the Jackson Estuarine Laboratory (JEL) on Great Bay, the Marine Program Building on campus, the Diamond Island facility on Lake Winnepesaukee 40 miles from campus, a research fleet composed of the 45-foot *R/V Jere A. Chase* and several smaller craft, and their pier facilities at JEL and in Portsmouth near the ocean. These facilities are available to all marine faculty and students. The University, in cooperation with Cornell University, also has facilities at the Shoals Marine Laboratory on Appledore Island of the Isles of Shoals, which focuses on marine biology and related subjects.

Major items of equipment available include a circulating seawater system at JEL, electronic microscopes, digital computers, a Beckman automatic amino acid analyzer, a liquid scintillation counter, a mass spectrometer, an auto analyzer, spectrophotometers, wave tanks and diving equipment. The *R/V Jere A. Chase* is equipped with radios, radar, Loran, an A-frame, and carries portable research tools such as gravity coring devices and dredges.

Marine science and oceanographic educational and research programs involve the Departments of Biochemistry, Botany and Plant Pathology, Earth Sciences, Microbiology, and Zoology, while ocean engineering education and research programs are conducted by the Departments of Chemical, Civil, Electrical and Mechanical Engineering. Additionally, marine research is also conducted by the Departments of Animal Sciences, Chemistry, Physical Education and Political Science.

Marine research proceeds on both an intra and interdisciplinary basis, being supported by such organizations as the National Sea Grant Program Office, the National Science Foundation, the Office of Naval Research, the National Institute of Health, the U.S. Coast Guard, and Woods Hole Oceanographic Institution. Research activities take faculty and students far afield to such places as the Arctic, Antarctic, mid-Pacific Oceans, and the North Sea, as well as to the neighboring marine environments of Great Bay and the Gulf of Maine. Examples of research studies include those relating to marine food chain, marine biotoxins, chemical, biological and thermal pollution, marine mineral resources, mariculture, marine resource management, marine law, environmental baseline data, arctic under-ice systems, diving systems, submersibles and underwater habitats. Many of these research activities are supported by an excellent diving program, which annually qualifies numerous faculty and student divers, in addition to facilities previously mentioned.

The following degrees are offered:

1. **B.S., M.S. and Ph.D. in Biochemistry** with specialization in marine biochemistry.

2. **B.S., M.S. and Ph.D. in Botany** with specialization in marine botany, granted by the Department of Botany and Plant Pathology.

a) **B.S.** Non-thesis degree requiring a minimum of 128 credits

b) **M.S.** Thesis degree requiring a minimum of 30 credits and defense of a thesis based on field or laboratory research

c) **Ph.D.** Doctoral dissertation degree requiring written and oral qualifying examination, defense of dissertation, a reading knowledge of at least one foreign language and, possible, proficiency in a cognate field such as computer techniques

3. **B.S. and M.S. in Chemical Engineering** with specialization in ocean engineering, granted by the Department of Chemical Engineering.

a) **B.S.** Non-thesis degree requiring a minimum of 129 credits. See Ocean Engineering Minor Program

b) **M.S.** Thesis degree requiring a minimum of 30 credits. Thesis may be waived by reason of previous research

c) **Ph.D.** See Ph.D. in Engineering

4. **B.S. and M.S. in Civil Engineering** with specialization in ocean engineering, granted by the Department of Civil Engineering.

a) **B.S.** Non-thesis degree requiring a minimum of 131 credits. See Ocean Engineering Minor Program

b) **M.S.** Thesis or project degree, the thesis degree requiring a thesis and 24 credits and the project degree requiring a written paper on a projects course in addition to 30 credits of coursework and comprehensive examination

5. **B.A. and B.S. in Geology and B.A. Science Major with Earth Science Concentration** with specialization in the marine earth sciences, granted by the Department of Earth Sciences.

a) **B.A. in Geology.** Non-thesis degree requiring a minimum of 128 credits, 32 credits being in the earth sciences

b) **B.S. in Geology.** Non-thesis degree requiring a minimum of 128 credits, 48 credits being in the earth sciences

c) **B.A. Science Major.** Non-thesis degree requiring a minimum of 128 credits, 24 credits being in the earth sciences

6. **M.S. and Ph.D., in Earth Sciences/Oceanography** requires a major in geology, chemistry, physics, mathematics, engineering, or in the biological sciences, and requires completion of one year each of college chemistry, calculus and physics. Undergraduate preparation will determine the area of specialization for the program.

7. **M.S. and Ph.D. in Geology** (with specialization in one area of oceanography) requires completion of one year each of college chemistry, calculus, and physics.

a) **M.S.** degree requirements: a minimum of 30 credits of a specific curriculum, including an earth

sciences graduate seminar and two or more courses related to their specialty; an oral presentation of thesis work; a thesis

b) **Ph.D.** degree requirements: reading knowledge of an appropriate foreign language, passing a qualifying examination, generally after two years of study; teaching experience equivalent to at least half-time for one year; completion of significant original research described in a dissertation; and passing an oral defense of that work. Course requirements are flexible.

8. **B.S. and M.S. in Electrical Engineering** with specialization in ocean engineering, granted by the Department of Electrical and Computer Engineering.

a) **B.S.** Non-thesis degree requiring a minimum of 133 credits. See Ocean Engineering Minor Program.

b) **M.S.** Thesis or independent research degree, unless waived by reason of equivalent experience, requiring a minimum of 30 credits.

c) **Ph.D.** See Ph.D. in Engineering.

9. **Ph.D. in Engineering** with specialization in ocean engineering in the areas of Engineering Systems Design, Signal Processing, Theoretical and Applied Mechanics and Transport Phenomena, granted by the Engineering Ph.D. Program representing the Departments of Chemical, Civil, Electrical and Computer, and Mechanical Engineering.

A doctoral dissertation degree requiring a qualifying examination, defense of dissertation, a reading knowledge of at least one foreign language or, possibly, a proficiency in a cognate field such as computer techniques in addition to prescribed coursework.

10. **B.S. and M.S. in Mechanical Engineering** with specialization in ocean engineering, granted by the Department of Mechanical Engineering.

a) **B.S.** Non-thesis degree requiring a minimum of 128 credits.

b) **M.S.** Thesis or project degree; the thesis requires a thesis and 24 credits of coursework and the project degree requires a project and 28 credits of coursework. Individuals with special qualifications may substitute coursework for the project.

c) **Ph.D.** See Ph.D. in Engineering.

11. **B.A., M.S. and Ph.D. in Microbiology** with specialization in marine microbiology, granted by the Department of Microbiology.

a) **B.A.** Non-thesis degree requiring a minimum of 128 credits.

b) **M.S.** Thesis degree requiring a minimum of 30 credits and an oral examination on thesis and graduate coursework.

c) **Ph.D.** Doctoral dissertation degree requiring qualifying examination, defense of dissertation, and one semester of teaching or previous equivalent experience.

12. **B.A., M.S. and Ph.D. in Zoology** with specialization in marine zoology, granted by the Department of Zoology.

a) **B.A.** Non-thesis requiring a minimum of 128 credits.

b) **M.S.** Thesis or special problem degree requiring a minimum of 30 credits and an oral examination on thesis and graduate coursework.

c) **Ph.D.** Doctoral dissertation degree requiring oral qualifying examination, defense of dissertation and written examination demonstrating proficiency in at least one foreign language.

The **Ocean Engineering Minor Program** recognizes undergraduate engineering students who acquire a nucleus of knowledge about engineering pertaining to the ocean and the coastal zone. In addition to meeting the University minor requirements of 20 semester hours, students must complete satisfactorily a minimum of 5 courses from a core curriculum of ocean-oriented courses in the earth sciences and engineering.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director, UNH Marine Program

University of New Hampshire

Durham, NH 03824

(603) 862-2994

UNIVERSITY OF NORTH ALABAMA

Florence, Alabama 35632-0001

The University of North Alabama, through its participation in the Marine Environmental Science Consortium of Alabama which is housed at the Dauphin Island Sea Lab, is able to present a major in Marine Biology. This program represents a specific option within the professional biology major and requires the student to spend two summers at the Dauphin Island Sea Lab where they take a minimum of sixteen semester hours of marine science courses. Information on the research and support facilities available at the Dauphin Island Sea Lab is cited under the listing for the Marine Environmental Sciences Consortium of Alabama in this publication.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Dean, School of Arts and Sciences

University of North Alabama

Florence, AL 35632-0001

(205) 766-4100 x288

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

Chapel Hill, North Carolina 27514

The University of North Carolina has teaching and research facilities on the campus at Chapel Hill, at the Institute of Marine Sciences at Morehead City, and at the Wrightsville Marine Biomedical Laboratory, Wil-

mington. Courses are taught on campus in several departments and research projects are also conducted in departmental laboratories. Special research facilities on campus include Uniboomer sub-bottom profiling system, Salinity/Temperature/Depth profiling system, radio tracked current drogue, Radium-226/Radon-222 isotope counting system; biological incubators; electron microscopes, gas chromatographs, infrared spectrometer; gamma spectrometer; mass spectrometer, liquid scintillation counters, and computer center. The principal research facility is the Institute of Marine Sciences. A new laboratory building providing 20,000 square feet of space was completed on the shore of Bogue Sound in 1968. The *R/V Machapunga*, a 48-foot diesel-powered vessel specially built for estuarine research, is equipped with radiotelephone, fathometer, generators for 100 volt a.c. and 32 volt d.c., and a hydraulic winch for handling gear; it has a 600-mile cruising range and living accommodations for four persons. Several out-board-powered small boats are available.

Additional facilities at this coastal laboratory include a library, research collections of fishes, decapod crustaceans, and mollusks, photographic darkroom, radioisotope facilities, a large pier, a running saltwater system in a separate wing of the laboratory, large outdoor seawater tanks, and experimental seawater ponds. Research equipment includes microscopes, in situ salinometers, sampling bottles, nets and trawls, pyreheliometers, submarine photometer, oxygen and carbon dioxide analyzers, histological equipment, gas chromatograph, spectrophotometers, and many other types of general laboratory equipment.

Special equipment at Wrightsville Marine Biomedical Laboratory includes pressure chambers to simulate terrestrial environments from +30,000 to -6,000 feet above sea level, together with apparatus and instrumentation for physiological and neurological studies; special problems in physical chemistry and strength of materials can also be undertaken.

The following degrees are offered:

1. **Ph.D. in Marine Sciences** (Curriculum in Marine Sciences). For the Ph.D. degree each student will ordinarily take at least four of the following courses: Oceanography, Physical Oceanography, Geological Oceanography, Biological Oceanography, and Chemical Oceanography, although his committee may approve other courses as satisfactory substitutes. He must also take Seminar in Marine Sciences at least twice and will study or do research at a marine laboratory or on an oceanographic cruise in a program approved by his committee. The dissertation will be on a marine topic. A minor is optional. A reading knowledge of one foreign language is required. Every student must gain some teaching experience during his program.

2. **M.S. in Marine Sciences** (Curriculum in Marine Sciences). For the M.S. degree each student must earn at least 30 semester hours of credit, including the four core courses in physical, biological, chemical and geological oceanography degree or substitute courses that are satisfactory to his committee. He must take

Seminar in Marine Sciences at least once, and a period of residence at a marine station or on an oceanographic cruise will ordinarily be required. A thesis on a marine topic is required. A minor is optional. Every student must gain some teaching experience during his program.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman
Curriculum in Marine Sciences 045A
University of North Carolina
Chapel Hill, NC 27514

UNIVERSITY OF NORTH CAROLINA AT WILMINGTON

Wilmington, North Carolina 29403

The University of North Carolina at Wilmington, located on a 600-acre campus adjacent to the Atlantic Ocean, Intracoastal Waterway and Cape Fear River Estuary, has marine research and teaching facilities on its main campus as well as specialized research facilities at its Institute for Marine Biomedical Research at Wrightsville Beach. The principal facility used for marine science programs on campus is the 40,000 square foot Marine Sciences Building which presently houses the Department of Biological Sciences and Earth Sciences and the Program for Environmental Studies. It contains several classrooms, 14 teaching and research laboratories, specialized equipment and work areas, and conference rooms. The Institute for Marine Biomedical Research is housed in an aggregate of four buildings totaling 12,000 square feet. More than a dozen specialized laboratories and various supporting facilities, including an instrument and machine shop and animal quarters, are provided. The University owns a fleet of small boats ranging from 14 to 23 feet in length and a 73-foot trawler used for research. Vessels are berthed at the University-leased marina at Wrightsville Beach, a few minutes drive from the campus.

Marine-related academic programs include a marine biology curriculum leading to the B.S. degree, an environmental studies curriculum with an emphasis in marine sciences leading to the B.A. degree, and a graduate program in marine biology leading to the M.S. degree.

The undergraduate marine biology curriculum includes a basic introduction to the field of biology with an emphasis at the upper level in various aspects of marine biology. The environmental studies curriculum is a multidisciplinary one in which students may elect to emphasize marine sciences. This curriculum is designed to expose the student to a broad range of research procedures in the natural and social sciences, while allowing each student to develop in-depth capabilities in marine science. The graduate program is designed (1) as a terminal degree program preparing students for a marine-related profession, (2) to prepare

students for a doctoral program elsewhere, (3) to upgrade proficiency of secondary public school teachers. The program curriculum consists of three tracks, one of which the student must elect: Marine Biology, Biological Oceanography, and Coastal Biology.

The following UNC-W degrees are offered:

1. B.S. in Marine Biology

- a) At least 37 semester hours in biology and marine biology
- b) Year courses in general chemistry and physics
- c) Precalculus or calculus
- d) Additional physical science electives

2. B.A. in Environmental Studies with a concentration in marine sciences

- a) Introduction to the environment and environmental studies senior seminar
- b) Statistics and computer sciences
- c) Four natural sciences environmental courses
- d) Three social sciences environmental courses
- e) A minimum of 20 semester hours in upper marine science courses.

3. M.S. in Marine Biology

- a) At least 30 semester hours of graduate study; a minimum of 24 hours must be completed in residence
- b) Demonstrate competency in a foreign language or a computer language
- c) Written and oral comprehensive examinations and a thesis based on original research are required
- d) Program must be completed within five years of the date of first registration for graduate study

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman
Department of Biological Sciences
University of North Carolina at Wilmington
Post Office Box 3725
Wilmington, NC 28406
(919) 791-4330 x2470

UNIVERSITY OF NORTH DAKOTA

Grand Forks, North Dakota 58202

The fisheries program at the University of North Dakota does research in various freshwater bodies of water in North Dakota including Garrison Reservoir, Lake Ashtabula, and nearby streams and lakes. The department has access to a recording depth finder, limnology equipment, capture gear, electrical resistance thermometers and several small fishing boats.

The University of North Dakota offers a B.S. degree in Fishery and Wildlife Management. The fisheries option of this degree places emphasis on freshwater sport fishery management. It requires 51-54 semester hours in biology and courses in geology, chemistry and mathematics. They also offer the M.S. and Ph.D. in Biology with fisheries or limnology options.

DEPARTMENT OF BIOLOGY:

UNDERGRADUATE: The Department of Biology offers concentrated study in four areas: Biology, Botany, Zoology and Fishery and Wildlife Management. The objective of these majors is to provide students with a broad knowledge of modern biology through training in each of the major areas of biological science: ecologic, genetic, molecular, morphologic and systematic biology.

In addition to the classrooms and specialized teaching laboratories, the Biology building houses an herbarium, animal rooms, greenhouses, a controlled environment laboratory, wet labs, a darkroom and graduate student research laboratories. The Department also maintains three natural areas for use in teaching and research as well as the University Biological Station at Devils Lake.

Well qualified majors are used to participate in independent studies, honors work, or undergraduate research. Normally, studies of this nature are initiated by invitation from a faculty member. Students selected for these programs usually carry out their studies in the research laboratories of the individual professors. Research assistantships financed by faculty research grants may be available for part-time employment. The department participates in the University Honors Program through certain interdisciplinary colloquia, by honors credit in advanced courses, and by independent studies and tutorials in advanced topics.

The following undergraduate degrees are offered:

1. **B.S. with major in Biology**
2. **B.S. with a major in Botany**
3. **B.S. in Fishery and Wildlife Management**
4. **B.S. with a major in Zoology**
5. **B.S.Ed. with a major in Biological and Physical Sciences**

GRADUATE SCHOOL: The Department of Biology offers graduate studies leading to the Master of Science, Doctor of Arts and Doctor of Philosophy degrees. These programs are designed to prepare students for academic teaching and research, research in government service, and research and developmental opportunities in industry.

Biology faculty and graduate students occupy all or portions of two buildings. Starcher Hall houses an herbarium containing about 30,000 specimens, animal rooms, darkroom, greenhouses, vertebrate and invertebrate research museums, research laboratories for fisheries, limnology and biometry, and a controlled environment room with growth chambers. Chandler Hall contains the Institute for Ecological Studies.

The Biology Department is strongly oriented toward studies in field biology, and the Department operates three field stations for research and class use. The Devils Lake Station is located 90 miles west of Grand Forks and is suited for aquatic research. The Forest River Biology Area is 40 miles from the campus. It includes habitats suitable for studies in aquatic and woodland biology; spring brook, swamp, moist and

dry woods and a section of the Forest River. The Oakville Prairie Station consists of 800 acres of virgin upland and lowland prairies and is located 12 miles from the campus. Both of these areas have laboratory and housing facilities and, in addition, Oakville Prairie has facilities for year-round bioclimatological studies. A fourth area consists of 600 acres of old fields located 17 miles from the campus. This tract is used for studies of secondary succession and wildlife management.

The North Dakota Fishery Research Unit, a cooperative operation of the Biology Department and the North Dakota Game and Fish Department, conducts research needed for and directed to the management of sport and commercial fisheries and the protection of aquatic environments in the State. The Department participates in the planning for the University of Minnesota Forestry and Biological Station in Itasca through representation on the Itasca Advisory Council.

The following degrees are offered:

1. **Master of Science.** The requirements are a 20-credit major (including research and thesis) and a 10-credit minor. The minor may be taken within the Department or from one of the other biological or physical science departments in the University. Other requirements include two credits of seminar and satisfactory completion of a comprehensive examination by the student's advisory committee.

2. **Doctor of Arts.** This degree program is designed to produce broadly trained biology teachers for the four-year and junior colleges. A dissertation is not required, but students must have some research and technical writing experience as part of their program. Only those persons holding a master's degree are eligible for admission to the program. A teaching internship is required as part of this program.

3. **Doctor of Philosophy.** The most important features of the Ph.D. program are the performance of an independent piece of research and the writing of a dissertation which is an original contribution to knowledge suitable for publication. Other requirements include six credits of seminar, reading knowledge of a foreign language, and attendance for one session at an approved field station, preferably marine or tropical. A minor is not required but each student is expected to show competence in related areas as determined by the student's advisory committee. Work completed on a master's degree program may be incorporated into the doctoral program if approved by the student's advisory committee.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman, Department of Biology

University of North Dakota

Box 8238, University Station

Grand Forks, ND 58202

(701) 777-2621

UNIVERSITY OF OREGON

Eugene, Oregon 97403

The University offers marine biology courses at both the main campus in Eugene and at Oregon Institute of Marine Biology, Charleston, Oregon. Modern science buildings in Eugene include laboratory facilities for Departments of Biology, Chemistry, Molecular Biology and Physics.

Oregon Institute of Marine Biology is located on about 85 acres along Coos Bay. The Institute buildings include dormitories, dining hall, classrooms and laboratories. There are six laboratory classrooms with running salt water, study tables and benches. One renovated building, used for year-round research, houses modern equipment such as a refrigerated centrifuge, spectrophotometers, and scintillation systems, Zeiss microscope equipped with Nomarski optics.

No degrees are offered by the Institute; however, the University of Oregon awards credit, including graduate credit for all courses designated (G) or at the 500 level. Work done at the Institute may form an integral part of the work towards *Bachelor's*, *Masters*, or *Ph.D.* degrees in Biology offered on the Eugene campus.

Courses in the marine sciences are offered during the regular year at the main campus by the Department of Biology. The Department of Biology also offers both regular summer and special workshop courses at the Institute. Independent studies and research have been carried out on a year-round basis at the Institute since 1968. A fall term program in biology includes Marine Ecology, Invertebrate Zoology, Estuarine Ecology, and research credit. During the spring, a multi-disciplined approach to man and his environmental problems will be offered entitled "People and the Oregon Coast." This program will include courses in biology, sociology, geography, landscape architecture and political science.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director

Oregon Institute of Marine Biology

Charleston, OR 97420

(503) 888-5534

The University of Oregon School of Law offers courses at the Legal Center building on the campus in Eugene. An Ocean Law Library and the facilities of the Law School Library are used for research. In conjunction with the Marine Advisory Program, the Law School conducts seminars at the Law Center and at various coastal locations, attended by members of Oregon ocean industries, Oregon State University oceanographers, other scientists, Oregon Law School faculty members and interested members of the bar and government.

The Oregon Law School Ocean Law Program is part of the Oregon State University Sea Grant College. The *J.D.* degree is offered.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Ocean Law Program

University of Oregon School of Law

Eugene, OR 97403

UNIVERSITY OF PUERTO RICO

Mayaguez, Puerto Rico 00708

The Department of Marine Sciences on the Mayaguez campus of the University of Puerto Rico is a graduate department, offering a program leading to *Master of Science* and *Doctor of Philosophy* degrees in marine sciences. The aim is to train marine scientists for careers in teaching, research and development. Students specialize in biological, physical, chemical, or geological oceanography, fisheries biology, aquaculture, or one of the areas within marine biology. They also gain an overall appreciation of marine sciences through core course requirements and electives. Much of the teaching and research is carried out at the marine station, 22 miles from Mayaguez, but students are able to elect courses in other departments and to use facilities at the computer center and the Center for Energy and Environmental Research on campus.

A minimum of 30 semester hours of credit in approved graduate courses is required for the Master of Science degree; 72 for the Ph.D. Courses in the Department of Marine Sciences are taught in English and Spanish. Because Puerto Rico has a Spanish culture and the University is bilingual, candidates are expected to gain a functional knowledge of Spanish as well as English before finishing their degree if they are not already proficient in both languages. In addition, all candidates are required to demonstrate, in an examination administered by the University's language department, the capacity to read and translate one other modern foreign language for the M.S. and two for the Ph.D. Further requirements for the M.S. and residence of at least one academic year, passing a departmental examination, completing a satisfactory thesis, and passing a comprehensive final examination; for the Ph.D., residence of at least two years, passing a comprehensive preliminary examination, completing a satisfactory thesis, and passing a final examination in defense of the thesis.

New teaching and research facilities, complete with ordinary and sophisticated equipment, exist both on campus and at the field station. A department library specializing in marine science publications is located in the campus building. The field station is on 18-acre Magueyes Island within a protected embayment off La Parguera, Puerto Rico. In addition to classroom-laboratory facilities, the station has indoor and outdoor aquaria and tanks with running seawater, a museum containing reference collections of fish, invertebrates, and algae, the 125-foot *R/V Crawford*, the 60-foot *R/V Medusa*, the 52-foot *R/V Pez Mar*, and a

number of smaller boats. In conjunction with the underwater research and training activities, the department operates a hyperbaric chamber housed at La Concepcion Hospital in San German. Research facilities for warm water aquacultures include some 8 acres of earthen ponds; sixty 10.5-square meter plastic pools; sixteen 4.7-square meter fiberglass tanks; thirty concrete tanks, one hundred 10-gallon aquaria; and 110 cylindrical hatching jars.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director, Graduate School

University of Puerto Rico

Mayaguez, Puerto Rico 00708

or,

Director, Department of Marine Sciences

University of Puerto Rico

Mayaguez, Puerto Rico 00708

UNIVERSITY OF THE PACIFIC PACIFIC MARINE STATION

Dillon Beach, California 94929

The marine station lies 60 miles north of San Francisco on the southern shore of Bodega Bay adjacent to Tomales Bay and just opposite the Point Reyes National Seashore. The high diversity of marine environments close by renders the area very suitable as a laboratory site. Sand beaches, intertidal sand flats, rocky shores, salt marsh, and kelp beds are within easy access. The local flora and fauna are correspondingly rich.

The station consists of three research and office buildings and several auxiliary structures; the former house teaching, research and instrument laboratories, photographic darkroom, museum, stockroom, and library. All laboratories are supplied with fresh seawater pumped directly from the ocean to two large holding tanks. The station maintains two research vessels: a 17-foot Boston Whaler and a 42-foot steel-hull vessel designed for offshore research.

GRADUATE PROGRAM: The Pacific Marine Station, a division of the University of the Pacific, is a year-round research center with a graduate program leading to a *Master of Science* degree.

The marine station's research program stresses ecology and systematics in the broadest sense. The principal theme of the ecology program is to determine the factors responsible for the seasonal and long-term changes in marine ecosystems. Current studies range from analyzing the effects of a variety of physical stresses on sand flat communities to evaluating the roll of predation in determining gastropod distribution on rocky shores. This program supplies the information necessary to develop sound impact studies and to

evaluate the disturbances caused by man. The ecology program provides both background data and a broader context for other scientific programs.

Studies on the functional morphology of marine organisms are aimed at a better understanding of the interrelationships between organ systems and environmental conditions. These studies are currently focused on more complete knowledge of feeding and nutritional biology in marine invertebrates, larvae, and the ecological implications of larval biology.

Graduate students are encouraged to participate in the research programs underway at the station. Research assistants work 50 percent of their time on the various projects. From their contact with staff members and the multitude of research problems that come to their attention during their involvement in the various ecology research programs, students have little difficulty in finding thesis problems.

UNDERGRADUATE PROGRAMS: The undergraduate program in marine science is designed for students of biology with upperclass standing. The 16 semester units are partitioned between two of the formal four-unit courses offered and eight units of research, normally on a specific problem related to one of the current research programs at the Pacific Marine Station. There are three main objectives of this program: (1) it affords undergraduates the opportunity of having a marine experience, of studying marine biology and ecology at the source; (2) the program provides an opportunity to carry on original research either within the context of one of the current faculty research programs or in some other area; (3) it is hoped that the scientific experience gained during this program will enable an individual to give thoughtful consideration to all of the parameters of complex environmental problems.

Upon completion of the program it is expected that a student will be able to: understand some of the complex relationships between species of animals, substrata, food chains, larval development and morphological adaptations; evaluate the scientific basis for statements in newspapers and magazines on conservation and the development of the natural resources; design a limited research program, and know how to apply scientific results to the solution of environmental problems.

Undergraduate students with advanced standing in biology will take two courses selected from those offered and spend the other two courses in participation in one of the station's on-going research projects. Departures from this scheme, including initiation of new projects, is possible by special arrangement.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director, Pacific Marine Station

University of the Pacific

Dillon Beach, CA 94929

UNIVERSITY OF RHODE ISLAND

Kingston, Rhode Island 02881

Marine-related education is an important function in several of the University's colleges. The most important fields are: Oceanography, Ocean Engineering, Marine Affairs, Fisheries and Marine Technology, Marine Resource Economics. In addition, there are faculty members with strong marine interests in other science and social science departments. The University is a Sea Grant College, and it operates several marine public service programs.

Marine-related education, research, and public service programs operate under the cognizance of the Provost for Marine Affairs. For information on specific programs, write the individual departments listed below.

GRADUATE SCHOOL OF OCEANOGRAPHY: The Graduate School of Oceanography maintains a group of laboratories, offices, and support facilities at the Narragansett Bay Campus, a waterfront location in Narragansett, Rhode Island. Principal structures are the Charles J. Fish Oceanographic Laboratory, the Francis H. Horn Laboratory, the Norman Watkins Marine Science Building, and the Claiborne Pell Marine Science Library. The graduate school operates the *R/V Endeavor*, a 177-foot research vessel, and a number of small craft.

The University offers the degrees of *Master of Science in Oceanography* and *Doctor of Philosophy in Oceanography*. Both degrees are given with options in biological, chemical, geological and physical oceanography.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Dean, Graduate School of Oceanography
Narragansett Bay Campus
University of Rhode Island
Narragansett, RI 02882

DEPARTMENT OF OCEAN ENGINEERING: The Department of Ocean Engineering operates an excellent coastal research vessel, an acoustics tank, a tow/wave tank, an excellent geotechnical laboratory, a corrosion laboratory, and a computer laboratory. All of these facilities are available to students and faculty and they are maintained on the Bay Campus, some 6 miles from the main campus. The Department offers the **M.S.** and **Ph.D.** degrees in Ocean Engineering.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman, Department of Ocean Engineering
University of Rhode Island
201 Lippitt Hall
Kingston, RI 02881

CHEMICAL AND OCEAN ENGINEERING: Students enrolled in this curriculum follow the program of study for chemical engineering during the freshman, sophomore, and junior years. The senior year student will follow a core curriculum with concentration in ocean engineering applications.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman, Department of Chemical Engineering
University of Rhode Island
Kingston, RI 02881

MECHANICAL AND OCEAN ENGINEERING: This is a **B.S.** degree offered jointly by the two departments. Students enrolled in this curriculum will follow the program of study for Mechanical Engineering and Applied Mechanics until their senior year. At that point, a number of courses are elected from a larger number of ocean-related courses, some of which are given by the Ocean Engineering Department. Graduates of the program are thus equipped to move either into ocean industry or into traditional mechanical engineering positions.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Program Coordinator
Mechanical and Ocean Engineering Program
Department of Mechanical Engineering
University of Rhode Island
Kingston, RI 02881

CIVIL AND OCEAN ENGINEERING: Students enrolled in this curriculum will follow the program of study for Civil Engineering until the latter part of the junior year and the senior year. At that point, a number of courses are elected from a larger number of ocean-related courses, some of which are given by the Ocean Engineering Department.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Program Chairman
Civil and Ocean Engineering Program
Department of Civil Engineering
University of Rhode Island
Kingston, RI 02881

MARINE AFFAIRS PROGRAMS:

GEOGRAPHY AND MARINE AFFAIRS: The Department of Geography and Marine Affairs offers a **B.A. in Geography and Marine Affairs**. Thirty credits in this concentration, including courses in geography, marine policy, and oceanography, are required for graduation. A total of 120 credits is required for graduation.

GRADUATE PROGRAM IN MARINE AFFAIRS: The Graduate Program in Marine Affairs, which offers two master's degree programs, was established in 1969 for individuals interested in the study of the complex issues of marine management. It focuses upon marine policy in four functional areas: fisheries law and policy, coastal zone management, ports and shipping, and international law and policy of the oceans. Policy problems at the local, state, regional, national, and international levels are examined. In recent years some of the issues studied have been: conflicting interests between offshore oil drilling and the fishing industry, preservation of wetlands versus harbor development, the impacts of technological advances on the shipping

industry, and the developments in international ocean law at the Third United Nations Conference on the Law of the Sea.

The following degrees are offered:

1. **Master of Marine Affairs (M.M.A.).** Applicants for this program must have either a graduate degree in a field useful in ocean management, such as the behavioral sciences, ocean engineering, resources economics, political science, or public administration, or have at least five years' experience in some ocean-related activity. Enrollment is limited to 25 candidates annually.

In this program, students acquire basic knowledge and analytical skills through required and elective courses. The core courses are General Oceanography, Marine Geography, Economics of Marine Resources, International Ocean Law, and the Marine Affairs Seminar. Students also take 12 credit hours of electives in marine affairs and in other fields such as: community planning, fisheries technology, organizational management, geography, geology, oceanography, ocean engineering, political science, and resource economics.

Substantial independent effort is required in research projects and written work. The 30 non-thesis credits required for the degree may be earned in nine months of intensive, full-time resident study. The Marine Affairs Seminar is the focus of interdisciplinary exchange. The first segment relies heavily on outside speakers and resident faculty members. The second segment requires student presentations on specific problems selected from topics such as the various uses of the sea, international negotiations and the law of the sea, coastal zone management, and ocean research and development. A major research paper is assigned early in the fall to be submitted toward the end of the spring semester.

The Master of Marine Affairs degree program does not offer intensified specialization. It is intended to give an overall familiarity with the subject, and to fill in the gaps left by narrow specialization.

2. **Master of Arts in Marine Affairs (M.A.M.A.)** Potential applicants who do not have a prior graduate degree or the requisite marine experience to qualify for study toward the M.M.A. degree may make application for the degree of Master of Arts in Marine Affairs. This academic degree, counterpart to the professional M.M.A. degree, is a two-year, 45-credit thesis program. Candidates for the M.A. in Marine Affairs take the 24 required course credits of the Master of Marine Affairs Program and 15 elective credits. This combination enables a student to specialize in a given area and still receive the multidisciplinary influence of the M.M.A. program. A six-credit master's thesis of an interdisciplinary nature completes the program of study.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Coordinator

Graduate Program in Marine Affairs

Washburn Hall

University of Rhode Island
Kingston, RI 02881
(401) 792-2596

DEPARTMENT OF FISHERIES AND MARINE TECHNOLOGY:

The Department of Fisheries and Marine Technology, located in the College of Resource Development, maintains a mini-campus on the waterfront in Wickford, Rhode Island, where training vessels are berthed. Facilities contain classrooms and practical teaching laboratories for seamanship, navigation, marine electricity and electronics, electronic aids, diesel and hydraulics technology. The 47-foot vessel, *Gail Ann*, is fully equipped with electronic aids including Loran C and sonar, being outfitted to provide training in all important fishing techniques.

A two-year Associate Degree Program (**Associate in Science**) is directed primarily toward preparation for the commercial fishing industry; an option aimed toward more general marine technology is available. All students are required to complete 72 credits over a two-year period—51 in professional commercial fisheries and 21 in general education and background subject matter.

A four-year Bachelor Degree Program (**B.S. in Resource Development**) is administered within the B.S. curricula of the College of Resource Development. Within the total requirement of 130 credit hours, students may shape a program of studies to meet individual needs, professional objectives, and career goals by appropriate selection among requirements for a basic core, major area of concentration, directed electives, and free electives.

A **Graduate Certificate Program in Commercial Fisheries** is to be taken in conjunction with the Master of Marine Affairs degree. Fifteen credits beyond the 30 needed for the MMA are required, together with specified course selections for nine credits of MMA program electives. Six credits of special problems in Fisheries and Marine Technology are mandatory. Students without previous in-depth background in applied commercial fisheries are required to fulfill preparatory study arranged to suit individual needs.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Department of Fisheries and Marine Technology

University of Rhode Island

Kingston, RI 02118

DEPARTMENT OF RESOURCE ECONOMICS: The Department has an undergraduate (**B.S.**) program and offers an **M.S. in Resource Economics** and a **Ph.D. in Economic-Marine Resources**. The undergraduate program addresses the economics of marine and other natural resources including commercial fisheries, aquaculture, and land use. Undergraduate training in Resource Economics is preparation for positions in state, regional, and federal government, and for continuing study at the graduate level.

At the graduate level, the Department offers an M.S. degree in Resource Economics. Areas of concentration include aquaculture, fisheries management, the economics of recreation, offshore oil and gas, and land use planning. This program trains students to assume positions with government agencies or in private industry concerned with marine resource management.

The Department offers a non-thesis **Master of Science degree in Fisheries Business Economics** with cooperation from the College of Business Administration. In this program about half the coursework is taken in the Department and about half in the College of Business Administration, and the purpose of the program is to prepare students for work in the private sector of the economy.

The Ph.D. program in Economics-Marine Resources trains students in economic and resource economics theory, marine policy and applied quantitative techniques. Graduates of the program are hired in research and teaching positions in government, industry and at academic institutions.

A close liaison exists with the University's Sea Grant Program, Graduate School of Oceanography, Center for Ocean Management Studies, and International Center for Marine Resource Development.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Department of Resource Economics

University of Rhode Island

Kingston, RI 02881-0801

(401) 792-2471

UNIVERSITY OF SOUTH CAROLINA

Columbia, South Carolina 29208

The Marine Science Program offers B.S., M.S. and Ph.D. degrees. Additionally, graduate work in the Biology of Geology Departments can have a marine emphasis. The Marine Science Program provides an interdisciplinary approach to the study of estuarine and coastal waters and includes several projects in deep ocean waters. Students may choose to specialize in biological, chemical, geological or physical oceanography. Within the curriculum, other specializations such as environmental modeling, oceanographic data processing, coastal engineering, and marine affairs, can be developed. Each program is specifically tailored to the individual's interest and career objectives.

The Belle W. Baruch Institute for Marine Biology and Coastal Research provides the research focus for marine science projects at the University of South Carolina and enables the Marine Science Program to accommodate the research goals of individual students. The research facilities of the Marine Science Program are located both in the new Earth and Water Sciences

Center on the University's main campus in Columbia and at Hobcaw Barony just north of Georgetown, South Carolina. Modern field laboratories; a conference center; living quarters; environmental chambers; saltwater holding systems; monitoring, sampling, and collecting gear; boats; and a launching ramp are available for the conduct of coastal marine research.

The following degrees are offered:

1. **B.S. in Marine Science.** Upon completion of the freshman year, the student will select an area of specialization consistent with his/her interests. Each student will plan his/her individual program in consultation with a faculty advisor. Requirements:

- a) Basic core courses
- b) Thirty hours in interdisciplinary major subjects
- c) One year of chemistry and physics
- d) Computer Science
- e) A calculus sequence

2. **M.S. in Marine Science**

- a) Thirty credits including six for thesis research
- b) Four core courses in: biological, physical, geological, and chemical oceanography
- c) Presentation of a Master's Thesis
- d) A comprehensive examination

3. **Ph.D. in Marine Science**

- a) Completion of four core courses in Marine Science
- b) Qualifying examination, written and oral
- c) Reading knowledge of one foreign language
- d) Reading knowledge of a second foreign language or six hours credit in either statistics or computer science
- e) Comprehensive examination
- f) Presentation of a dissertation
- g) Dissertation defense

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director, Marine Science Program

University of South Carolina

Columbia, SC 29208

(803) 777-2692

UNIVERSITY OF SOUTH FLORIDA

Tampa (33620) and St. Petersburg (33701), Florida

Marine Science is a unique interdisciplinary department in the College of Natural Sciences of the University of South Florida. It is devoted to research, graduate instruction, and public service in biological, chemical, geological, and physical oceanography. Over seventy M.S. degrees have been awarded since the formation of the department in 1967. In July, 1981, the Florida State University System Board of Regents approved an independent Ph.D. program for the Department of Marine Science to complement the previously existing cooperative program with the Department of Oceanog-

raphy of Florida State University (FSU). Research emphasis will continue to be placed on interdisciplinary efforts in marine biology, chemistry, geology and physics. Some students, particularly in physical oceanography, may find it advantageous to work through the cooperative program with FSU.

A minimum of 30 and 90 semester hours beyond the baccalaureate are required for the *M.S. and Ph.D. degrees*, respectively. Both degrees require the writing of a thesis or dissertation based on original research performed by the student. The Master's degree in Marine Science is intended for those who wish to qualify for positions in various state, federal government, or private research laboratories and businesses, and for those who wish eventually to work toward the Ph.D. The Ph.D. program in Marine Science is intended primarily for those who have already earned the Master's degree and who wish to qualify for more responsible positions in marine related organizations including colleges and universities. Demonstration of ancillary research skills in two areas (e.g., foreign languages, computer programming) and satisfactory performance on a written and oral qualifying examination are required before a student may be admitted for candidacy for the Ph.D.

The Marine Science Department occupies a large building (82,000 square feet) located on a peninsula at Bayboro Harbor, adjacent to downtown St. Petersburg. The harbor is able to accommodate any ship in the U.S. fleet of oceanographic vessels, making the department ideally situated for an oceanographic research operation. Construction of a new machine shop and warehouse building will be completed in 1983.

The Department of Marine Science operates a number of boats, ranging in size up to 36 feet. Two larger ships, the 65-foot *R/V Bellows*, and the 110-foot *R/V Suncoaster*, are generally available through the Florida Institute for Oceanography (FIO), which is located in the same building as the Department of Marine Science. FIO serves faculty members at all the institutions of the State University System by providing shiptime, equipment, and, at times, coordination for multi-institutional proposals. The Department's specialized facilities include laboratories for trace metal analysis, water quality, organic and isotope geochemistry, optical oceanography, sedimentology, micropaleontology, benthic ecology, phycology, bacteriology, ichthyology, and planktonology, and a flume laboratory for interdisciplinary boundary-layer studies.

Approximately nine state-supported assistantships are available each year for beginning students. After their first year, students are expected to work with a professor on a grant-supported project. One-half time assistantships pay in the range of \$5,000 to \$6,000 for the nine-month academic year. In addition, some out-of-state tuition waivers are available to first-year students.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Chairman, Department of Marine Science
University of South Florida
140 Seventh Avenue South
St. Petersburg, FL 33701
(813) 893-9130

UNIVERSITY OF SOUTHERN CALIFORNIA INSTITUTE FOR MARINE AND COASTAL STUDIES

Los Angeles, California 90007

The Institute for Marine and Coastal Studies (IMCS) was established in 1975 by the University of Southern California to manage and develop the University's extensive marine programs and facilities, many of which have been in existence since the early 1900's. The Institute supports teaching and research in three principal areas; marine science (oceanography), ocean engineering, and marine policy (law, economics, political science, etc.). More than 100 courses are taught in these disciplines in some 14 departments, colleges, and professional schools at USC. Many of the Institute's professional staff hold joint appointments with other departments.

Marine science courses are offered at both the main campus in downtown Los Angeles and at the Catalina Marine Science Center on Santa Catalina Island, 22 miles offshore from the Los Angeles coastal plain. In addition, field work is conducted on the *research vessel*, the *Velero IV*, a 100-foot Pacific Tuna Clipper Design vessel. The IMCS also operates a coastal research vessel, the 65-foot *Sea Watch*; the 37-foot *Golden West*, equipped for diving support and nearshore sampling; and the 28-foot *Espoir*, used for commuting equipment and personnel to and from the Catalina Marine Science Center. All are located at the Marine Support Facility in Wilmington, which also houses an Oceanographic Instrumentation Calibration Center, the Harbors Research Laboratory for on-location harbor studies, and the Marine Advisory Services component of the Institute's Sea Grant Program.

The Catalina Marine Science Center provides extensive laboratory and living facilities for scientists and students in a well-protected marine environment. The Center includes a 30,000 square foot laboratory building with classrooms, a lecture hall, and a library. Specific capabilities include: fresh water circulating systems for all laboratories; microtechnique laboratories; herbarium; zoological museum; cold room; constant temperature room; two environmental chambers; electron microscope; and machine shop. The Center operates several small boats, a diving support complex (with air compressor, two diver-propulsion vehicles, underwater television equipment, surface-air gear, and

underwater communications equipment), one of three hyperbaric chambers on the west coast (used for treatment of diving victims and for physiological research), and a marine railway for launching and retrieving manned submersibles. A larger pier to facilitate docking of large research vessels and a helipad to facilitate emergency operations for incoming diving victims are recent improvements.

The Center offers a year-round program of courses in cooperation with the Department of Biological Sciences and the School of Medicine. One of these, the Catalina Semester, allows students the opportunity to spend a semester at the Center for two 7½-week sessions. Formal classes are held 5½ days a week, and sample courses include: Marine Phycology, Marine Biology, Marine Invertebrate Zoology, Biological Oceanography, Ichthyoplankton, Underwater Research, Neurosciences, and Hyperbaric Physiology.

Also on Catalina Island is the Mt. Ada Marine Conference Center in Avalon. Mt. Ada was once the Catalina home of Mr. and Mrs. William Wrigley, Jr. It was donated to the University in 1978 for use as an academic and cultural center, capable of accommodating up to 100 conference participants. Ample commercial lodging facilities are located within walking distance of the Center.

On-campus facilities for marine research range from a major central computing facility (along with several auxiliary systems) to specialized laboratories for various areas of marine biology, marine geology, geophysics, geochemistry, ecology, oceanography, coastal and ocean engineering, and paleontology. The Allan Hancock Foundation's Library for Oceanography and Marine Bio'ogy, aside from containing several thousand volumes on numerous marine science specialties, also produces a monography service devoted to basic and applied research, field surveys, and data reports in the marine sciences. The Hancock Foundation possesses one of the largest collections of marine invertebrates and algae on the Pacific Coast.

The Institute's diversified research program totals about \$4 million yearly. Its largest single component, the Sea Grant Institutional Program, is concerned primarily with the planning and management of California's coastal resources. Funded by the National Oceanic and Atmospheric Administration, the State of California, and other sources, Sea Grant deals with marine resources development (living and non-living), environmental quality, coastal zone management, and marine education.

The greater Los Angeles region is a virtual laboratory for the student of marine science. Los Angeles has the second largest port complex in the United States, the largest fishing port, and segments of nearly every maritime industry. Thus, marine research problems abound in the local area and various IMCS programs address specific research problems endemic to the local area. The Harbors Environmental Projects, for example, have played a major role in accumulating and analyzing

sound scientific information concerning the Los Angeles/Long Beach Harbor areas. Data from Harbor Projects' reports has been used extensively in environmental statements and assessments.

Much of the Institute's research, however, deals with ocean problems of universal importance which extend beyond California's geographic boundaries. In addition to basic problems in marine biology, geology, oceanography, and coastal engineering, there are complex political and social issues which receive a great deal of attention from the Institute's diverse professional staff of marine engineers, biologists, geologists, social policy analysts, and legal experts, who frequently combine their skills in the search for adequate solutions. This reflects the multidisciplinary approach to marine studies at USC.

Some of the Institute's programs have very specific research goals, such as the new Marine and Freshwater Biomedical Center. In 1978, the National Institutes of Environmental Health Sciences designated USC as one of four universities nationwide to establish such a center. The Center focuses its research on cardiovascular, neurobiologic, and carcinogenic problems in marine fish and mammals as they apply to humans.

A new Center for Marine Transportation Studies began teaching and research activities in early 1980. Designed to bring together the disciplines of public administration, business administration, and marine science, the Center offers graduate degrees and certificates in marine transportation. The Center's purpose is to train managers in various aspects of ocean trade, transportation, and port and harbor management within the framework of a graduate academic program. The Center sponsors seminars, workshops, and short courses to bring together professionals already in the field.

ACADEMIC PROGRAMS: USC offers a wide range of academic possibilities for the prospective marine sciences' student. Seven advanced degree programs are available in marine science specialties in the departments listed below:

1. M.S./Ph.D. in Biological Sciences with marine science emphases are offered by the Department of Biological Sciences. The Department offers approximately 41 graduate and undergraduate courses in various marine science topics. Nearly 50 percent of the department's faculty have marine biology specializations.

The M.S. requires three full biology graduate courses, two seminars, and additional graduate courses and/or research units for a total of at least 24 units, as well as a thesis. The Ph.D. requires five full graduate courses, six seminars and additional graduate units for a total of 60 units; qualifying examination and dissertation are required as well. After admission into the Ph.D. in Biological Sciences program, students are given a background examination in the major fields of biology. Students prepare a curriculum of course and research training in consultation with their advisory

and guidance committee. Although the qualifying examination in the second year is common to all doctoral students, considerable specialization is allowed for those engaged in marine science areas. Shipboard and teaching assistance experience is required for students involved in relevant oceanic biology areas. Thesis topics and other specific areas of research will be defined mainly by faculty interests, and an ability to undertake independent research is demanded. Laboratories exist in Science Hall, the Hancock Foundation Building, and the Ahmanson Center for Biological Research in addition to the extensive facilities of the Catalina Marine Science Center. Courses are offered both on campus and at the Center.

2. M.S. and Ph.D. in Geological Sciences with marine science specializations offered. The Department of Geological Sciences has a faculty of over 50 percent in marine sciences, and 23 undergraduate and graduate courses in marine specialties are offered. Fourteen faculty members teach and conduct research in a wide range of areas from bottom topography to environmental aspects of coastal geology.

The requirements for the Ph.D. in Geology with specialization in Marine Geology, Geophysics and Geochemistry of the Oceans follow the general requirements of the Graduate School and usually require a minimum of four years to complete. Only students of high ability are accepted as candidates after demonstrating their competence in a screening examination in the first year, a comprehensive written and oral examination after two years, and the successful defense of the original dissertation. Usually the student is required to successfully demonstrate a reading knowledge of one foreign language, or they may substitute their competence in statistics, computer use or an advanced basic science minor. The path of the student's studies is directed by the Guidance Committee following the successful passing of the screening examination. The M.S./M.A. in Geological Sciences with specialization in Marine Geology and Oceanography follows the same entrance qualifications as above and the candidate must have passed 24 hours of graduate work with a grade point average of 3.0/4.0. A thesis is required. The master's committee is selected after the screening examination of the first year is successfully completed. The master's is generally required before the Ph.D. can be sought except in cases of exceptional ability. A master's degree normally requires two years to complete.

3. M.S. in Ocean Engineering. Offered by the Department of Aerospace Engineering, the M.S. in Ocean Engineering is directed toward preparing students for a professional career in one of many ocean-engineering oriented activities. The program is interdisciplinary in nature and flexible enough to satisfy the needs of individual students with a variety of backgrounds and interests. Applicants with a bachelor's degree in any area of engineering or science who have the ability to pursue graduate study are eligible for this program. The program consists of 27 semester units or the

equivalent of nine courses. Thesis work at the master's level is optional. The program can be completed in three semesters of work, although it is possible to satisfy the requirements in two semesters. Possible fields of specialization include: ocean dynamics, coastal engineering, and ocean structures. Other possible areas include ocean communications, systems design, public administration, system safety, and marine pollution.

4. M.S. in Environmental Engineering. Offered by the Department of Environmental Engineering, the M.S. program is intended to prepare students for a professional career in any one of many environmental engineering activities. It is interdisciplinary in nature; applicants with a bachelor's degree in any area of engineering or science who have the ability to pursue graduate study are eligible for this program. Students are required to take coursework and pass a comprehensive examination. Normally it requires one academic year of full-time study beyond the B.S. level. Possible areas of specialization include ocean waste management, water pollution problems and ecosystems.

5. Marine Policy Programs. Arrangements have been made to include a marine affairs program as an acceptable field for specialized doctoral study in the School of International Relations, the School of Public Administration, the Department of Economics and the Department of Political Science. Students wishing to do marine affairs work at the graduate level are encouraged to apply for enrollment into one of these more general disciplines at USC. In addition, joint programs in Environmental Management can be arranged between the School of Urban and Regional Planning and other schools and departments. Examples would be joint Master's programs in Planning/Public Administration, Planning/Law, or Planning/Business.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Director

Institute for Marine and Coastal Studies

University of Southern California

University Park

Los Angeles, CA 90007

(213) 741-6840

UNIVERSITY OF SOUTHERN MISSISSIPPI

Hattiesburg, Mississippi 39406

The University, located less than 75 miles from the northern Gulf of Mexico, has been granted a leadership role for the development of marine science programs in the State of Mississippi. Modern facilities for instruction and research in aquatic and marine science are located on our main campus, and our close affilia-

tion with the Gulf Coast Research Laboratory (GCRL) at Ocean Springs, Mississippi, provides the opportunity for utilization of the facilities and personnel at this marine research laboratory (see GCRL listing).

In addition to our affiliation with GCRL, the University maintains collaborative associations with agencies at the nearby National Space Technology Laboratories (NSTL) located at Bay St. Louis, Mississippi. These include the National Marine Fisheries Service (NMFS), Naval Oceanographic Office (NAVOCEANO), Naval Ocean Research and Development Activity (NORDA), U.S. Fish and Wildlife Service, U.S. Geological Survey (USGS), and the U.S. Coast Guard.

Degree programs available at the University that provide the opportunity to emphasize marine science are as follows:

1. The Department of Biology offers **B.S., M.S. and Ph.D. degrees** with an emphasis in Marine Biology.
2. The Department of Geology offers **B.S. and M.S. degrees.**

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Dean, College of Science and Technology

University of Southern Mississippi

Southern Station, Box 5165

Hattiesburg, MS 39406-5165

(601) 266-4883

UNIVERSITY OF SOUTHWESTERN LOUISIANA

Lafayette, Louisiana 70504

The principal research and teaching facilities of the University are located on the main campus in Lafayette, Louisiana. The University is also an active participant in the Louisiana Universities Marine Consortium (LUMCON) and has access to Consortium laboratory facilities and research vessels in Cocodrie, Louisiana, about 120 miles from the main campus. Access is also available to LUMCON's two satellite field stations, one near Grand Isle, Louisiana, the other on Vermilion Bay, Louisiana, about 30 miles from the main campus. Access to other marine environments is often available through cooperative programs with state and federal agencies. Marine research and education opportunities are also provided on an occasional basis through the USL Tropical Field Expedition Program which to date has centered on studies along the east coast of Mexico.

The University presently operates one 17-foot research vessel and several smaller outboards and skiffs. A wide array of sampling equipment is available for marine field studies. Campus facilities include a variety of marine research and teaching laboratories in the Biology, Geology, and Microbiology Departments. Special facilities include a newly completed wing of the Biology Department which houses wet labs, cold rooms, environmental room, systematic collections,

instrument laboratories, an SEM-TEM laboratory, and photography laboratories. Other specialized research equipment available on campus includes highly advanced computer facilities, instrumentation for chemical and physiological analyses, sediment analysis equipment, and a variety of research quality light microscopes.

No degrees are specifically entitled as marine science, but marine studies may be emphasized by students in choosing courses toward the following degree programs:

1. **Bachelor of Science in Botany**
2. **Bachelor of Science in Aquatic and Fishery**

Biology

3. **Bachelor of Science in Wildlife Management**
4. **Bachelor of Science in Zoology**
5. **Bachelor of Science in Microbiology**
6. **Bachelor of Science in Geology**

General requirements for the above degrees include: a minimum of 124 semester hours successfully completed toward a degree program; a minimum grade point average of 2.0; minimum residence requirements of two semesters and 30 credit hours; a minimum of 45 hours successfully completed in upper-level courses. Other requirements vary by department.

At the graduate level, students may select marine-oriented research projects and course programs in pursuing the following degree programs:

1. **Master of Science in Biology**
2. **Master of Science in Microbiology**
3. **Master of Science in Geology**

General requirements for the above degrees include: a minimum of 30 graduate-level course hours; completion of an acceptable thesis (exceptions may be made in Geology); a minimum of 24 graduate-level hours completed in residence; and successful completion of comprehensive and final examinations. The student must also satisfy any specific department requirements for the degree to which he aspires.

The **Doctor of Philosophy in Environmental and Evolutionary Biology** is a new program as of 1983.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Head

Department of Biology, Box 42451

University of Southwestern Louisiana

Lafayette, LA 70504

(318) 231-6748

UNIVERSITY OF TAMPA

Tampa, Florida 33606

The University of Tampa is located on the Hillsborough River a few miles from Tampa Bay and 18 miles from the Gulf of Mexico. A wide variety of marine habitats are located in the Tampa Bay area including tidal marshes, sea grass meadows, oyster

reefs, sandy beaches, offshore areas, and live bottom communities. The Marine Science Department maintains a custom built 45-foot teaching/research vessel equipped for trawling, dredging, scuba diving, snorkeling, and hydrographic sampling. For those students interested in scuba experience, underwater techniques are taught as an integral part of the program. Two smaller boats are available for work in shallow waters.

Laboratories are well-equipped with a variety of ecological and physiological instrumentation. Chemical facilities include gas and liquid chromatographs, nuclear magnetic resonance spectrometer, polarograph, and infrared spectrometer.

An internship program provides with practical experience and credit in marine related programs in firms or agencies throughout the year. Through an affiliation with the Gulf Coast Research Laboratory in Mississippi, a variety of marine courses are offered during the summer.

The following degrees are offered:

1. **B.S. in Biology** with concentrations in ecology, cell biology and preprofessional areas. Requirements include nine biology courses, four chemistry courses (General and Organic), General Physics, and Pre-calculus.

2. **B.S. in Marine Science/Biology** requires eight biology courses, six marine science courses, and the courses listed above for chemistry, physics and mathematics.

3. **B.S. in Marine Science/Chemistry** requires three biology courses, six marine science courses, eight chemistry courses, General Physics and Calculus II.

4. **B.S. in Marine Science/Biology/Chemistry** requires eight biology courses, six marine science courses, eight chemistry courses, General Physics and Calculus II.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Division of Science and Mathematics

University of Tampa

Tampa, FL 33606

(813) 253-8861

THE UNIVERSITY OF TEXAS

Austin, Texas 78712

The University of Texas offers programs in marine-related sciences through the Port Aransas Marine Laboratory of the Marine Science Institute and the Institute for Geophysics, located at the main campus in Austin.

PORT ARANSAS MARINE LABORATORY: Facilities for graduate work in marine studies are located at the Port Aransas Marine Laboratory (PAML) of the

Marine Science Institute. PAML is located on Aransas Pass Inlet near Corpus Christi, Texas. It occupies buildings among the dunes at the tip of Mustang Island, with easy access to bays, beaches, and the open Gulf. Environments readily accessible include the hypersaline Laguna Madre, oyster reefs, underwater grass flats, rock jetties, mud-bottom bays, beaches, and continental shelf.

The Port Aransas facility includes a library, classrooms, constant temperature growth chambers, sea water facilities, shops, and garages. A dock laboratory is on pilings over Aransas Pass. Twenty outdoor experimental ponds with filtered or raw seawater are available. The Laboratory provides a new air-conditioned 82-foot coastal research vessel, a 44-foot trawler, a 40-foot self-propelled barge, and several smaller boats and related equipment, in addition to an assortment of vehicles for field use. Dormitory facilities are available. A recent expansion program has provided a new laboratory building with complete running seawater facilities for one-third of the floor-space, a physical plant building, a dormitory, and an apartment complex. A combination library-auditorium building is nearing completion.

Graduate degrees in marine sciences are offered through affiliation with the Departments of Botany, Microbiology, Zoology, Biological Sciences, Chemistry, and Environmental Health Engineering (Civil Engineering) at the University of Texas, Austin. Course requirements are those set by the particular department.

The following degrees are offered:

1. **Master of Arts and Doctor Philosophy** programs in biological or physical sciences may be concentrated in the area of marine science. Marine Science and related courses listed in the various Austin campus science departments may be used as supporting work for marine science programs.

2. **M.A. in Biological Sciences (Botany and Zoology), Chemistry or Microbiology** with work concentrated in marine sciences. Nine to 12 hours of marine science as the minor may be combined with 12-15 hours of the major and six hours of thesis registration for a total of 30 hours. The program of study and the thesis are approved by a supervisory committee appointed by the dean.

3. **Ph.D. in Biological Sciences (Botany and Zoology), Chemistry or Microbiology** with work concentrated in marine science. Requirements and examinations for admission to candidacy vary according to the specifications of the graduate faculty of the major department at Austin. German, French or Russian is generally used to fulfill the language requirement in most of the related science departments. There is no set number of course hours required. The program of study, languages, final oral examination and doctoral dissertation are approved by a supervisory committee and the dean.

Courses in marine studies are offered during the regular long session at the Austin campus. The Marine

Science Institute offers regular summer courses and thesis research, as well as special problem courses, all year long at Port Aransas. Additionally, PAML offers continuing summer sessions composed of marine biology, oceanography and marine chemistry to upper division and graduate level students (resident students or summer transient students).

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
The Graduate Advisor
University of Texas Marine Science Institute
Port Aransas Marine Laboratory
Port Aransas, TX 78373
(512) 749-1267

INSTITUTE FOR GEOPHYSICS: The Institute for Geophysics is closely associated with the Department of Geological Sciences in Austin, but also operates the Galveston Marine Geophysical Lab and an associated marine operations base. Facilities include a VAX 11/780 computer system with the DISCO seismic data processor, and the *R/V Fred Moore*, outfitted for multi-channel seismic data acquisition. Regions of interest include the Gulf of Mexico, Caribbean, offshore Alaska, and Indonesia.

Graduate degrees (*M.S.*, *Ph.D.*) are offered through the appropriate academic departments of the University with students pursuing courses and research in the Institute for Geophysics and other closely related departments.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
The Graduate Advisor
Institute for Geophysics
The University of Texas at Austin
P. O. Box 7456
Austin, TX 78712
(512) 471-6156

**UNIVERSITY OF TEXAS
MEDICAL BRANCH
THE MARINE BIOMEDICAL INSTITUTE**
Galveston, Texas 77550

The Marine Biomedical Institute (MBI) is a component of The University of Texas Medical Branch at Galveston, Texas. The MBI has three divisions. The Administrative and Comparative Neurobiology Divisions are housed in the Sealy-Smith Professional Building, which is adjacent to the Medical Branch campus, and the Marine Medicine Division occupies space in the same building and also in several buildings on the campus. The laboratories in the Sealy-Smith Building are dedicated to research activities and include an aquarium facility for maintenance of marine organisms, both invertebrate and vertebrate, and a variety of equip-

ment for work in such fields as electrophysiology, biochemistry (including mass spectroscopy), transmission and scanning electron microscopy, and behavioral analysis. In League Hall are facilities for the maintenance of captured squid, and for experimental work in squid mariculture. There is also a collection of preserved marine organisms caught in the Gulf of Mexico. A separate building contains a hyperbaric medicine facility, with a chamber for patients needing treatment with hyperbaric oxygen and also a laboratory for experimental work in diving physiology.

The MBI has two research vessels: the *R/V Erin Leddy-Jones* and the *R/V Virginia Blocker*. The *R/V Erin Leddy-Jones* is a 51-foot fiberglass stern trawler especially designed for collecting marine organisms close to the shore of the Gulf of Mexico. The *R/V Virginia Blocker* is a 41-foot Hatteras used particularly for collecting in the bay system and for explorations requiring diving. There are also smaller boats for diving operations and for estuarine work. The vessels are berthed at a dock belonging to The University of Texas adjacent to the Medical Branch.

The MBI is not involved in undergraduate education. However, members of the MBI belong to the faculty of the Medical Branch and the Graduate School of Biomedical Sciences, and so they participate actively in teaching the medical and graduate school curricula and in residency training. In addition, there is a substantial postdoctoral research training program. *Ph.D.* degrees are not offered through the MBI but rather through regular graduate programs in which members participate.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director
The Marine Biomedical Institute
200 University Boulevard
Galveston, TX 77550

UNIVERSITY OF VIRGINIA
Charlottesville, Virginia 22903

DEPARTMENT OF ENVIRONMENTAL SCIENCES:
The major facilities of the Department of Environmental Sciences are on the grounds of the University of Virginia, Charlottesville. These consist of a major building, Clark Hall, which houses classrooms, offices and laboratories, additional research laboratories in the Chemistry Building, and several semi-permanent field sites on the outer banks of North Carolina and the Virginia Barrier Islands, the Shenandoah National Park, and the Shenandoah Valley.

The Office of the State Climatologist is housed with the department as are all of the historical climate data. Several thousand salmon has been developed and is maintained by the School by the release of thousands of fingerlings each spring. Brookstocks of rainbow

tological records of the Commonwealth. In addition to modern analytical laboratories for environmental chemistry and biochemistry and biogeochemistry the department maintains a hydrodynamic and hydraulics laboratory and freshwater and marine aquaria systems.

The department offers a **Bachelor of Arts** which requires 30 hours of coursework consisting of the stipulated core courses with their laboratories plus 14 additional hours within the department. In addition, calculus and biology, chemistry or physics are required. An undergraduate thesis is required for an honors degree.

At the graduate level the **Master of Arts**, **Master of Science** and the **Doctor of Philosophy** are offered. All graduate degrees require demonstrated proficiency of the undergraduate core courses and a thesis or dissertation. For the Master of Arts, 33 hours of coursework are required plus a library thesis. The Master of Science requires 24 hours of coursework and an original thesis. The coursework and foreign language requirements for the Ph.D. are established by the graduate student's individual committee.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman, Department of Environmental Sciences

Clark Hall

University of Virginia

Charlottesville, VA 22903

(804) 924-7761

GRADUATE SCHOOL OF ARTS AND SCIENCES: The Graduate School of Arts and Sciences also offers the *Master of Arts in Marine Affairs*. This is an interdisciplinary degree drawing on coursework in the College of Arts and Sciences, the Law School (Center for Oceans Law and Policy), the School of Architecture (Planning), and the School of Engineering. The degree requires 30 hours of coursework. A thesis is required. Admission to the program is through the Faculty Advisory Committee on Marine Affairs.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman, Committee on Marine Affairs

Department of Environmental Sciences

Clark Hall

University of Virginia

Charlottesville, VA 22903

(804) 924-7761

UNIVERSITY OF WASHINGTON

Seattle, Washington 98195

The University of Washington offers a variety of marine science-oriented programs through the College of Ocean and Fishery Sciences using teaching and research facilities on its main campus and at several marine facilities in the Pacific Northwest and Alaska.

Courses dealing with the ocean and its use to marine scientists are also offered in the Departments of Atmospheric Sciences, Botany, Economics, Geography, Geological Sciences, Geophysics, and Zoology, and in the College of Engineering.

SCHOOL OF FISHERIES: The School of Fisheries in the College of Ocean and Fishery Sciences is concerned with research and training and investigation of possible ways to use stocks of fish and shellfish more effectively, how to make better use of all waters to produce more food from living organisms and how to cultivate aquatic plants and animals more effectively.

The School is also concerned with the impact of pollution, of industry and of population pressure on the aquatic environment, both as these affect fisheries and also other uses of our waters. In general, the program of the School provides opportunity for training not only in fisheries, but in the management of natural resources and in the understanding and use of the aquatic environment.

Founded in 1919, the former College of Fisheries, now the School of Fisheries in the College of Ocean and Fishery Sciences, has been intimately associated with the development and conservation of the fisheries of the northeastern Pacific Ocean. The School attempts to deal with the whole problem rather than with isolated technical questions, an approach which involves many phases of biology with particular emphasis on the quantitative aspects. Full attention is given to political, social, legal and economic problems associated with the use of resources. Although fishery problems in the Northwest are emphasized, they are examined as case histories, with many features applicable to problems of harvesting aquatic resources throughout the world and, as a result, many foreign students register in the School.

Fishing and fish products are an important part of the total food industry. The Institute of Food Science and Technology offers undergraduate and graduate curricula to prepare food scientists for industry, government and academia. The undergraduate program provides a broad coverage of all phases of food technology with some additional specialization in fisheries technology. Graduate programs are strongly based on microbiology, chemistry, biochemistry, physiology and engineering and emphasize an experimental approach to the solution of problems. There are four major divisions in the new School, namely Aquaculture and Invertebrate Fisheries, Quantitative Science in Fisheries, Food Science and Technology, and Fisheries Science and Aquatic Ecology in addition to the Fisheries Research Institute. The Washington Cooperative Fishery Unit supported by the U.S. Department of the Interior, Washington State Department of Fisheries, and Department of Game is a part of the Fisheries Science and Aquatic Ecology Division.

DIVISION OF AQUACULTURE AND INVERTEBRATE FISHERIES: The Division in the School of Fisheries has a major research and teaching program in both salmonid and shellfish aquaculture. An annual run of

trout, catfish and carp are maintained at the School facilities for research and training.

Current study areas include the effects of different culture methods on salmonids and warmwater fish, response of developing salmonids and environmental changes, dietary requirements of young, rapidly growing fish and maturing broodfish, genetic assessment of cultured stocks, selective breeding of cultured strains, disease control, and fish biochemistry and behavior.

DIVISION OF QUANTITATIVE SCIENCE IN FISHERIES: The Center of Quantitative Science in Forestry, Fisheries and Wildlife is an intercollege academic unit sponsored by the College of Forest Resources and the School of Fisheries. The Center offers a broad program in applied mathematics and in applied statistics directed principally to the College of Ocean and Fishery Sciences and the College of Forest Resources and to other life science departments of the University. The applied mathematics program of the Center of Quantitative Science (CQS) is concerned with quantitative descriptions for the management of both aquatic and terrestrial ecosystems.

The teaching program of CQS consists of five areas of course offerings. These include (1) computer programming with particular emphasis on the problems of the management of living resources; (2) quantitative ecology including population, community and systems ecology; (3) operations research with particular focus on the utilization of renewable resources; (4) applied statistics with emphasis on statistical inferences and experimental design for the biological sciences; and (5) applied analysis consisting of differential and integral calculus applied to the life sciences. Courses in each of the five areas are inter-related so as to meet a wide range of student interests and needs.

DIVISION OF FOOD SCIENCE AND TECHNOLOGY/INSTITUTE FOR FOOD SCIENCE AND TECHNOLOGY: The Division of Food Sciences and Technology and the Institute operate together, thus incorporating teaching, research and advisory service programs in Food Science into a single unit. The teaching program includes undergraduate and graduate instruction.

The Research activities within the Institute are concentrated in food microbiology, food chemistry, food engineering, seafood technology, food safety, environmental microbiology, and nutrition. At least one specific research project is usually active within each of these areas. These projects provide opportunities for research training for both undergraduate and graduate students in Food Science. Industrial research is carried out on an ad-hoc basis by the Institute at the request of food companies. Such research, which is paid for by the companies, is encouraged.

DIVISION OF FISHERIES SCIENCE AND AQUATIC ECOLOGY: The Division of Fisheries Science and Aquatic Ecology is concerned with the teaching of

fisheries resource management, aquatic ecology and ichthyology. Research on these subjects is carried out by the Fisheries Research Institute and the Washington Cooperative Fishery Research Unit.

Teaching in this Division is at both the undergraduate and graduate level. The teaching emphasis is on the biological and ecological processes which must be understood in order to successfully manage living aquatic resources. Such courses as functional anatomy, ichthyology, fish physiology, fish ecology, and aquatic pollution teach basic information and principles while advance courses on such topics as resource assessment by hydroacoustics and the use of microcosms to study ecological relationships, teach the theory and application of modern-day techniques used by fisheries scientists managing aquatic resources.

FISHERIES RESEARCH INSTITUTE: The Fisheries Research Institute is a research branch of the School of Fisheries. Many of the School's grants and contracts in the field of fishery biology are handled by the Institute under the direction of both teaching and research faculty. The research programs provide practical training opportunities for fisheries students as well as support and thesis research under the guidance of the faculty with the assistance of the technical staff. The research projects in the Institute provide a wide spectrum of opportunities for thesis research, and financial support for these activities comes from diverse sources. Annual reports of research are available from the School of Fisheries upon request.

Basic requirements for admission to the graduate program in the College are a bachelor's degree from an institution of recognized standing with a grade point average of 3.00 in the junior and senior years of college work.

The following degrees are offered in the School of Fisheries:

1. Bachelor of Science and Bachelor of Science in Fisheries. Bachelor's degrees require completion of a common core curriculum in basic science (30 quarter credits), mathematics and statistics (9-11 quarter credits), environmental science (11 quarter credits), and social science (11 quarter credits). In addition to the core curriculum, the student selects one or two sets of prescribed courses from seven areas of emphasis. The sets consist of 25-30 quarter credits. The areas of emphasis are: fish culture, invertebrate culture, recreational fisheries, aquatic resource management, water quality, fish processing, and general environmental study.

2. Bachelor of Science (Food Science). To obtain this degree in the food science program, the student must complete the requirements for university graduation with at least 10 credits in humanities and biological studies. Courses in biochemistry, chemistry, mathematics, physics, preventive medicine and specified fisheries and food science courses are required.

3. Master of Science. At least one year of approved study with a completion of a research project and

thesis leads to the master's degree. A minimum of 45 upper-division or graduate credits must be presented including 18 credits in specified fisheries or food science courses and three additional credits in courses numbered 500 or above.

4. Doctor of Philosophy. Students must complete at least three years of graduate study including a dissertation. Credits earned for a master's degree may be applied toward the doctor's degree. Students must demonstrate proficiency in translation of one foreign language.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director

School of Fisheries, WH-10

University of Washington

Seattle, WA 98195

(206) 543-4270

SCHOOL OF OCEANOGRAPHY: The School of Oceanography has laboratory and ship facilities located along the Lake Washington Ship Canal on the main campus. The School occupies three permanent buildings (two of which were constructed in 1967 and 1968). Research vessels ranging in size from 65 to 208 feet (the *R/V Hoh*, *R/V Onar*, and *R/V Thomas G. Thompson*) are operated by the School for inshore and deep-sea studies.

Special facilities include a closed saltwater system, controlled environment room, a tidal model of Puget Sound, wave tanks and rotating models, shipboard and shore-based Prime 300 computers, a paleomagnetism laboratory, a sea-ice laboratory, a gas chromatograph, x-ray emission and gamma-ray spectrometers, particle counters, provisions for work with radioactive isotopes, a chemostat laboratory, and a scuba support facility. Also available are an excellent Fisheries-Oceanography Library, a well equipped developmental laboratory, and the University Computer Center. Teaching and research facilities in the School also use the University's Friday Harbor Laboratories, a marine biological station on San Juan Island, about 80 miles north of the main campus.

The School offers the *Bachelor of Arts* and the *Bachelor of Science* degrees. The student in either curriculum must meet a set of fixed requirements outlined in the University bulletin.

Students who have majored in oceanography or another science and appear likely to succeed in graduate study can be accepted in the program of the School of Oceanography. Admission is based on grade records, letters of recommendation, and the results of the Graduate Record Examination. Students who have not majored in oceanography, should acquire a broad background in science and mathematics equivalent to the requirements for the baccalaureate degrees in oceanography. Additional information can be obtained from the Graduate Program Office.

The student specializes in biological, chemical, geological, geophysical or physical oceanography; inter-

disciplinary studies are possible. All requirements of the Graduate School must be satisfied.

The School offers a thesis and a non-thesis program leading to the Master of Science degree. In both, the student and his or her advisor prepare a program of study to be approved by the student's supervisory committee. A departmental comprehensive written examination is required. Language requirement is determined by the student's faculty advisor.

The School also offers a program leading to the **Doctor of Philosophy** degree. The student and his supervisory committee prepare a program of study and research and the student must pass a general examination in oceanography and supporting fields. He then completes the research for his dissertation and prepares for his final examination.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Curriculum Advisor

School of Oceanography, WB-10

University of Washington

Seattle, Washington 98195

(206) 543-5039

INSTITUTE FOR MARINE STUDIES: The need for new approaches in education and research concerning marine policy arises from important recent developments at the national and international levels. These developments reflect an awakening public and private interest in the accelerating needs and technological capabilities of man to use and develop the ocean and coastal waters.

The Institute for Marine Studies was established to expand opportunities for more comprehensive and interrelated study and research of contemporary marine problems. The purpose of the Institute is to create and to foster innovative interdisciplinary courses of study and new approaches to marine policy research.

The Institute has 13 full-time faculty members, and a total of 28 faculty representing the fields of oceanography, environmental studies, fisheries sciences, atmospheric sciences, engineering, marine law, economics, geography, political science and public policy are currently associated with the Institute.

The Institute offers an academic program in the following areas: Coastal Zone Management, Marine Policy, and Marine Resource Management. Students with a particular interest in other areas of concentration (i.e., marine transportation and commerce, offshore technology systems) may under some circumstances be able to make special arrangements to pursue this interest. The programs are designed to meet the needs of students with varied academic backgrounds and different levels of education and experience.

The Institute has developed a program of study leading to the **Master of Marine Affairs (M.M.A.)** degree. An approved thesis and 69 credits of coursework including nine credits of thesis research are required.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Graduate Program Advisor
Institute for Marine Studies, HA-35
University of Washington
Seattle, WA 98195
(206) 543-7004

OCEAN ENGINEERING PROGRAM: The Ocean Engineering Program based in the College of Engineering at the University of Washington has been designed to take advantage of the breadth of marine and engineering-oriented curricula on campus and of the proximity of the campus to various marine environments. The undergraduate student may obtain a Bachelor of Science in Engineering degree through the Interdisciplinary Engineering Studies Program. Graduate students may enroll in a graduate degree program offered by the faculty of the engineering department that best fits their background and objectives, or may pursue a **Master of Science** degree through the Inter-Engineering Program. The program for the particular student is arranged on an individual basis and includes courses in the various engineering departments with related coursework in the College of Ocean and Fishery Sciences, Oceanography, Fisheries, and the Institute for Marine Studies.

Laboratory facilities on campus and in the field are used to support teaching and research in ocean engineering. A large Chemical Engineering Laboratory with special facilities such as a 20-foot glass distillation column, a 20-foot absorption column, and a fluid (air and water) loop for research and calibration is available. Laboratories for hydraulics, wave studies, structures, materials, soil mechanics, water biology, and chemistry are located in Civil Engineering. Those for acoustics, electronics and control systems, and energy conversion are in Electrical Engineering. Mechanical Engineering has laboratories of heat transfer and thermodynamics, experimental stress analyses, material processing, and vibrations and acoustics. A ceramics laboratory and those for material properties and mineral processing are available through Mining, Metallurgy, and Ceramics. Nuclear Engineering has a separate teaching and research facility. Part of the work done by the Applied Physics Laboratory is marine-oriented and, when appropriate, a student's thesis research may be performed at this laboratory. A floating semi-submersible instrument platform is available for field research. The platform is designed to minimize wave excited motions and is instrumented with wave staffs and an anemometer. Data collection and processing are controlled by an onboard data acquisition system. Outstanding collections of books and periodicals of interest to the engineer and marine scientist and a research computer laboratory round out the facilities.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Director, Ocean Engineering Program, FU-10
126 Mechanical Engineering Building
University of Washington
Seattle, WA 98195
(206) 543-7446

LAW AND MARINE AFFAIRS: For students who have completed the first degree in law, the School of Law at the University of Washington offers a course of study in law and marine affairs leading to the LL.M. degree. Particular emphasis is placed upon the interdisciplinary aspects of marine affairs. Curricular offerings are available in the School of Law, the Institute for Marine Studies, the Graduate School of Public Affairs, the College of Engineering, the Department of Economics, and the Department of Geography.

Requirements for conferral to the LL.M. degree include the satisfactory completion of 40 quarter credits of coursework and research, of which a minimum of 15 must be in the School of Law.

Persons interested in applying for the LL.M. program should do so early in the school year because the deadline for completed application occurs in Spring Quarter.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Graduate Program Advisor
Law and Marine Affairs
School of Law, JB-20
University of Washington
Seattle, WA 98195
(206) 543-4550

DEPARTMENT OF BOTANY: The Department of Botany is based in the College of Arts and Sciences. The Department's principal teaching and research facilities are located in Johnson Hall and the Biological Sciences Building on the main campus and at Friday Harbor Laboratories. These include marine and freshwater algal culture facilities, numerous cultures of marine algae, a collection of preserved algae in a special algal herbarium, and scuba diving equipment. There are boats for field work and a larger vessel is available at the Friday Harbor Laboratories for dredging operations.

In addition to the **Bachelor of Science** degree program in botany, the department offers both a **Master of Science** degree and a **Ph.D.** degree program, with special emphasis in marine algology and marine mycology.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairperson, Department of Botany
430 Biological Sciences Bldg. KB-15
University of Washington
Seattle, WA 98195
(206) 543-1942

DEPARTMENT OF ZOOLOGY: The Department of Zoology's offices and laboratories are in Kincaid Hall on the main campus with facilities for advanced instruc-

tion and research including controlled environment seawater aquarium rooms. The modern facilities of the Friday Harbor Laboratories on San Juan Island are also available for instruction and research on marine organisms.

While the department does not offer a degree in marine biology, students pursuing degree programs may strongly emphasize this area by selecting a variety of marine biology courses in fulfilling the degree requirements. Two undergraduate degree programs are offered: **Bachelor of Arts** and **Bachelor of Science**. Candidates for either must meet the requirements of the College of Arts and Sciences.

Graduate programs in the Department of Zoology including coursework and research lead to the **Master of Science** and **Doctor of Philosophy** degrees. A non-thesis master's program is also offered. The major fields of interest in the department are cellular and developmental biology, general and comparative physiology, ecology and ethology, and vertebrate and invertebrate zoology. A graduate student interested in marine biology may take several courses in the department or in one of a complex of departments of biological sciences at the university. Entering students should have completed the following courses: organic and/or physical chemistry, one year of college physics, mathematics through calculus, and a survey of the plant kingdom. All students are required to gain some teaching experience regardless of source of support. With the objective of insuring a broad background in zoology, an entering graduate student participates in a diagnostic conference with a faculty committee. The student's academic strengths and weaknesses are assessed in view of the student's interests and a course of studies is prescribed. A general oral examination taken in the third or fourth year includes the defense of an original research proposal and precedes candidacy for the Ph.D. degree.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Chairman, Department of Zoology
106 Kincaid Hall, NJ-15
University of Washington
Seattle, WA 98195
(206) 543-1620

UNIVERSITY OF WEST FLORIDA

Pensacola, Florida 32514

The University of West Florida is an upper-level state university located at the north end of Escambia Bay. Two programs with a marine orientation are offered: Coastal Zone Studies and Marine Biology.

COASTAL ZONE STUDIES: Drawing upon the expertise found in different disciplines, Coastal Zone Studies at the University of West Florida is based on three departments: Biology, Earth and Atmospheric

Sciences and Political Science. Each of these departments contributes to Coastal Zone Studies through core and elective courses, research projects and a faculty committee formed to ensure a comprehensive yet integrated approach for the study of our coasts and oceans.

At present, two separate degrees at the master's level are offered in Coastal Zone Studies: the **Master of Science in Biology** for marine-science-oriented students, and the **Master in Publication Administration** for marine affairs-oriented students. These professionally accredited degrees in fields of long standing and easy recognition allow the student to have wide employment opportunities. Some students take all the coursework necessary to obtain both the M.S. in Biology and the M.P.A. in Public Administration for more indepth knowledge in Coastal Zone Studies.

The curriculum in Coastal Zone Studies has been designed to provide a balanced set of courses. Each contributing department offers a total of six hours. At the end of the 18 hour set, a seminar is offered that integrates the knowledge gained from the three disciplinary perspectives. Total hours required for either master's degree is 36. As part of this program a paid internship is used in lieu of a thesis.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director, Coastal Zone Studies
University of West Florida
Pensacola, FL 32514
(904) 474-2330

MARINE: BIOLOGY: This program is based solely in the Biology Department and is offered at both undergraduate and graduate levels. The undergraduate curriculum is based upon a core of required courses considered by the faculty to be fundamental to specialization in the field of Biology. These core courses, which total 20 semester hours, are: biochemistry, genetics, developmental biology (embryology), ecology, and comparative animal physiology.

The following departmental requirements must be satisfied before a student receives a **B.S. in Biology**: a grade point average (GPA) of 2.0 or greater (on a 4-point scale) in all biology courses taken; completion of the assigned biology core courses with no grade less than "C"; completion of at least two academic terms of organic chemistry and a course in statistics or calculus; and completion of the recommended number of elective biology courses to meet specific track requirements.

In addition to the core courses, the student must complete 18 semester hours of biology electives which include one course in botany and 14 semester hours of courses with a marine emphasis. Students also may elect to participate in directed studies on marine topics for credit.

Students completing the marine biology track receive a B.S. degree with Marine Biology indicated as

the area of specialization. Few institutions offer a marine biology program at the undergraduate level, and so this degree is rather unique.

The Department of Biology offers graduate training culminating in the **Master of Science degree**. A majority of the faculty is engaged in grant-funded research involving marine, estuarine and freshwater organisms. Currently there are about 35 graduate students in the program; Significant opportunities exist for cooperative research with the staff at two major federal laboratories. A new program in Coastal Zone Studies has been established to train people who can contribute to ecology/management problems in the coastal zone. Faculty from biology, environmental sciences and political science are involved in the program.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chair, Department of Biology

University of West Florida

Pensacola, FL 32514

(904) 474-2746

UNIVERSITY OF WISCONSIN MADISON

Madison, Wisconsin 53706

The University of Wisconsin-Madison with its 100-year tradition in limnological research is recognized worldwide as a leader in this field.

The Oceanography and Limnology Graduate Program has been in existence at the University of Wisconsin-Madison since 1962. An interdepartmental program leading to a M.A. or Ph.D. degree in Oceanography and Limnology or a minor in this field is available and provides graduate training in aquatic sciences with a strong interdisciplinary flavor. This is not a campus department, but rather a committee degree program designed to meet the need for interdisciplinary work.

A complete understanding of the oceans and inland waters — their origin, inhabitants, potential as providers of food and minerals, and their social and economic effects on humans — requires the application of nearly all the sciences.

Accordingly, the Oceanography and Limnology Graduate Program at the University of Wisconsin-Madison is interdepartmental, composed of faculty from the Departments of Bacteriology, Botany, Civil and Environmental Engineering (including Water Chemistry), Food Science, Geology and Geophysics, Meteorology, Plant Pathology and Zoology. Each of the faculty members has active research programs.

RESEARCH FACILITIES AND MAJOR PROGRAMS:

The Aquaculture Research and Demonstration Facility is well-equipped for studying cool-water species; present research projects include fish nutrition, genetic selection for species improvement, reproductive physiology and engineering and economic aspects of perch production for food markets via aquaculture.

The Center for Limnology was established July 1, 1982, to plan, conduct and facilitate the limnological and aquatic ecological research programs at the Laboratory of Limnology on Lake Mendota and the Trout Lake Station in the Northern Highlands of Wisconsin. The Center is a division of the College of Letters and Science and is used by faculty, staff and students from various campus units for research on the lakes and streams of Wisconsin. The facilities are also available for visiting researchers interested in limnology and aquatic ecology.

The University Computer Center houses a Univac 1110. Other computers readily available across campus include the Geophysical and Polar Research Center's Harris 6024/3 which is available for marine and limnological data analysis.

Equipment and support facilities for research in a variety of specialized areas of microbiology is available through the Department of Bacteriology. These include an electron microscope laboratory, anaerobic laboratory, isotope rooms, plant growth chambers, animal quarters, high voltage electrophoresis room and a fermentation pilot plant. In addition, there are excellent opportunities for field work in the area of aquatic microbiology.

The Department of Geology and Geophysics houses extensive facilities for chemical and mineralogical analysis. An automated electron microprobe, scanning electron microscope, stable isotope mass spectrometer, atomic absorption spectrophotometers (2), auto analyzer system for nutrient chemistry, ion chromatograph, UV-VIS spectrophotometers, single crystal and powder x-ray diffraction equipment, and computer facilities for data analysis/data reduction/data base management are all housed in Weeks Hall.

The Great Lakes Research Facility operated by the Milwaukee campus is available to graduate students on the Madison campus. It also offers a wide range of laboratory and field access facilities to Southern Lake Michigan.

The Hydraulics Laboratory located on the engineering campus, has facilities for instruction and research, including a wave tank and a turntable for conducting Coriolis studies.

The University's main library reference facility, the Memorial Library, catalogues over two million volumes. The Kurt F. Wendt Engineering and Physical Sciences Library provides access to two computer terminals which allow direct entry into data bases at Lockheed in Palo Alto, California, and the Argonne National Library in Oak Ridge, Tennessee. There are departmental libraries in biology, earth science, life science, limnology and physical science.

The Northern Highlands of Wisconsin are one of the most diverse lake districts in the world. These lakes were extensively studied by Birge, Juday and their colleagues in the early 1900's. The lakes around the Trout Lake Station are now a site for a National Science Foundation long term research project. A balanced program is aimed at documenting long term trends

in physical, chemical and biological properties of lakes, understanding the interrelations among biological, physical and chemical processes and their relation to the climatic and hydrologic environment, and determining the stability and resiliency of lake ecosystems to natural and anthropogenic disturbances.

The Marine Studies Center carries out research on the oceans and Great Lakes and serves as an oceanography information center for the University of Wisconsin-Madison. The center's research is directed toward an understanding of ocean and Great Lakes environments, the solution of marine resource problems, and the study of marine resource policy. The Marine Research Laboratory, the natural science arm of the Marine Studies Center is located in a separate building.

The Geophysical and Polar Research Center includes a scanning electron microscope, an electron probe, and extensive sediment pore fluid chemical analysis center and a pool and associated facility for testing sonic devices. There are also portable instrument shelters for large ship programs on the Great Lakes and in the oceans. Seagoing microprocessor systems for recording data, logging navigation and processing data have been developed. A laboratory computer is also available.

Field studies are particularly important to marine and aquatic research and the University of Wisconsin-Madison owns and operates several research vessels. The *R/V Aquarius* is operated by the Sea Grant Institute and is based at Sturgeon Bay on Lake Michigan. The *Neeskay* is operated on Lake Michigan by the Center for Great Lakes Studies at the University of Wisconsin-Milwaukee. Both of these vessels are specifically outfitted for oceanographic survey work such as bottom coring, hydrographic casts, BT surveys, dredging and trawling, and chemical, physical, biological and meteorological observation. University of Wisconsin-Madison scientists also use research vessels operated by the University of Michigan, the Environmental Protection Agency, vessels of the University National Oceanographic Laboratory (UNOLS) fleet, and Army, Navy and Coast Guard ships and we have also used vessels such as the *R/V Eastward* (Duke University) in the oceans. The *Limnos* is based on Lake Mendota at Madison. Specially outfitted pontoon boats and numerous smaller boats with outboards are used for lake study.

A number of coordinated ship-aircraft operations have been performed with the aid of research aircraft from the U.S. Navy, the Research Aviation Facility of the National Center for Atmospheric Research, the Wisconsin Department of Natural Resources and the Environmental Monitoring and Data Acquisition Group of the Institute for Environmental Studies.

In 1968 the University of Wisconsin-Madison became one of the first of six universities to be designated as a Sea Grant Institution followed by designation as a Sea Grant College. Supported by the federal National Oceanic and Atmospheric Administration and the State of Wisconsin, the Sea Grant College Program encom-

passes three areas of activity — education, research and advisory services — all focused on the utilization, conservation, and wise management of our marine and Great Lakes resources. The Sea Grant Program is organized into sub-programs: Living Resources, Aquaculture, Microcontaminants and Water Quality, Green Bay, Policy Studies, Diving Physiology, Ocean Engineering and New Applications. Advisory Services and Education are separate but are inherently included in the research subprograms.

The Water Chemistry Laboratory is situated on the shore of Lake Mendota in the Hydraulics Laboratory Building. The Water Chemistry Program conducts research on a wide range of water related problems.

The primary mission of the Water Resources Center is to encourage, plan, coordinate and administer research programs which are applicable to the solution of present and emerging water resources problems. The personnel of the Center are charged with identifying opportunities for advancing current research and information capabilities and promoting the transfer of water resources information to the state, federal and local agencies, the scientific community and the general public.

The Oceanography and Limnology Graduate Program emphasizes limnological studies and is based on the premise that limnology and oceanography is an integrated field requiring the same broad base in the fundamental disciplines. Individuals may specialize in a problem in limnology, oceanography or one common to both environments. Students entering the program are required to have had mathematics through integral calculus and one year each in biology, chemistry and physics. Students without these requirements may be admitted with deficiencies and are expected to make them up early in the program.

Study plans are individually tailored for each student by an Evaluation and Guidance Committee. This committee, set up in the first semester of residence, is composed of at least three faculty members and includes the major professor, one additional professor from the major field of interest and the third from another discipline. At least two must be from the Oceanography and Limnology faculty. This committee will meet with the student once each semester. The purpose of the committee is to design and review a program of study suited to the student's background, needs, research plan and career goals.

The following degrees are offered:

1. Master's Degree in Oceanography and Limnology. A candidate for the M.S. degree in Oceanography and Limnology must complete the following:

- a) A minimum of nine credits in three formal courses, with two courses in one discipline within the Oceanography and Limnology Program and one course in another discipline within the program.
- b) One seminar each semester, including the Oceanography and Limnology Seminar at least once per year.
- c) A Master's thesis or report.

d) An oral examination including defense of the Master's thesis or report to be administered by the Evaluation and Guidance Committee.

e) Need for field experience to be determined by the Evaluation and Guidance Committee.

f) Two semesters of residence on campus.

2. Ph.D. Degree in Oceanography and Limnology.

All Ph.D. candidates are expected to have or obtain a broad background in aquatic sciences and depth in their research area. A specific program will be designed to meet the needs of the individual student by an Evaluation and Guidance Committee. This committee either formed or reconstituted in the first semester of residence, has the responsibility for approval of the course program, recommendation of the minor, review of research plan, conduct of comprehensive examination and the defense of thesis. It will meet twice annually, with additional members added for the purpose of examination.

The broad background in aquatic sciences should include biology, chemistry, geology and physics. The major by the nature of the program, will include advanced courses in several sub-disciplines in limnology and oceanography. The minor may be used to obtain tools of research, to focus even more intently on a single discipline within limnology and oceanography, or to open additional areas related to the field, such as in the social sciences.

All students must take the Oceanography and Limnology Seminar at least one semester per year until graduation.

Need for field experience is to be determined by the Evaluation and Guidance Committee.

The Ph.D. candidate must demonstrate competency in a foreign language. Typically two years of college level coursework or an examination will suffice. The language chosen shall be one represented by a substantial body of relevant literature and must be approved by the Student's Evaluation and Guidance Committee. Exceptions may be sought from the Oceanography and Limnology Graduate Committee with the approval of the major professor.

Financial assistance to qualified students is in the form of research assistantships, fellowships and teaching assistantships, as available.

3. Ph.D. Minor in Oceanography and Limnology. Students working for a Ph.D. degree with a major in another department may elect to minor in Oceanography and Limnology. A minor program of at least 12 credits is developed individually for each student. It should strike a reasonable balance between the physical and biological sciences. The proposed minor must be approved by the Oceanography and Limnology Graduate Committee and by the Graduate School not later than halfway through the minor sequence. The Oceanography and Limnology Seminar should be taken at least once.

4. Master's Degree in Ocean Engineering. Ocean engineering activities and their integration with the

Oceanography and Limnology Program are coordinated by the Ocean Engineering Committee which consists of members from various engineering departments. An Ocean Engineering Master's Degree Program enables engineers to enter the field of oceanography and thereby apply their technical skills to this important area.

5. Master's Degree and Ph.D. Degree in Water Chemistry. Water Chemistry involves the application of the principles and methods of chemistry together with a knowledge of biology and the methods of engineering to the understanding of the processes controlling the chemical composition of natural waters, the relationships between natural waters and land-water and air-water interactions, and the methods of altering the composition of waters and wastewaters through chemical, physical, and biological treatment.

The Water Chemistry Program is an interdepartmental program within the Graduate School, offering M.S. and Ph.D. degrees in Water Chemistry. The program faculty includes members from the Department of Civil and Environmental Engineering, Chemistry, Geology and Geophysics, and Soil Science. The program laboratories are in the Hydraulics Laboratory Building near Lake Mendota where the Water Chemistry faculty in Civil and Environmental Engineering together with approximately 25 graduate students, several postdoctorates, specialists, and technicians are conducting research on a wide range of water-related problems. The water chemistry group works closely with engineers, limnologists, geochemists, soil scientists, meteorologists, botanists, and others on various research projects covering aspects beyond the scope of a single discipline.

The M.S. degree in Water Chemistry requires 13 credits of core courses in Water Chemistry and elective courses selected based on the area of water chemistry emphasized in the student's program. A thesis or research report is required.

For the Ph.D. degree in Water Chemistry, students must complete the courses required for the M.S. degree and additional water chemistry courses specified by the faculty committee. Ph.D. students also must complete graduate courses in two areas of chemistry. A minor in a department in the physical or biological sciences or a distributed minor is required. Completion of an oral preliminary examination and a research thesis are required.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Ocean and Limnology Graduate Program

Center for Limnology

680 North Park Street

University of Wisconsin-Madison

Madison, WI 53706

(608) 263-3264

or,

Chairman, Ocean Engineering Committee
College of Engineering
1415 Johnson Drive
University of Wisconsin-Madison
Madison, WI 53706

THE WATER RESOURCES MANAGEMENT PROGRAM: This interdisciplinary program, administered by the Institute for Environmental Studies, leads to the **Master of Science** degree in **Water Resources Management**; it is designed to prepare graduate students to manage water resources and solve water problems. The WRM Program requirements help students make connections between the biological and physical sciences (which identify and measure problems), engineering (which defines technological alternatives), and law and the social sciences (which assesses needs and potential for institutional responses). In its 30-credit, one year option, the WRM Program offers breadth in relevant management and planning concerns to the returning agency professional or advanced student. Open to all applicants, the 45-credit, two year option adds depth in the form of an area specialty. The WRM Program is designed to prepare graduate students for employment in water resources management and planning activities. As of 1982, there have been over 300 graduates of the program. Approximately 75% of these have entered public service, obtaining administrative and staff positions with federal agencies, numerous state resource development and water agencies, urban planning departments, counties, cities, regional planning and development bodies, universities, interstate water authorities, international agencies and foreign governments.

This degree program does not require a thesis or independent research project but requires instead a workshop. This interdisciplinary water management project is a team effort, involving usually 15-20 students, who culminate their program with this workshop during the 8 week summer session.

Requirements for the 45 credit program include: nine credits of Natural Science and Technology (physical and biological sciences and engineering courses); nine credits of Water Resources Institutions and Public Decision Making Processes; six credits of analytical and design tools in water resources management; six credits for the summer workshop and one credit for the spring planning seminar. The workshop, a culminating experience in the Program, is usually held during the summer and involves a student-faculty team project on a contemporary issue in water resources. Fifteen additional credits are required in area specialties, an intensive program of courses designed to provide the individual with competence in a particular water-related area.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director
Water Resources Management Program
Room 72, Science Hall
550 North Park Street
University of Wisconsin-Madison
Madison, WI 53706
(608) 262-0651

UNIVERSITY OF WISCONSIN-MILWAUKEE

Milwaukee, Wisconsin 53201

Located at a major Lake Michigan port, the University of Wisconsin-Milwaukee (UWM) has developed substantial capabilities for instruction and research on the Great Lakes. In addition to the basic marine-related curriculum noted below, the emphasis here is on the hydrodynamics, biology, geology, and socio-technological management of the Great Lakes environment, now generally regarded as part of the nation's coastal zone.

An inter-departmental Center for Great Lakes Studies (CGLS) serves as a campus-wide coordinating focus for marine and related research, particularly at the graduate level. The Center's facilities include: a 65-foot research vessel, the *R/V Neeskay*; smaller vessels; machine and instrument shops; fish-rearing laboratories; and a wide range of specialized equipment for laboratory and field research in geophysical fluid dynamics, marine geology and geophysics, geochemistry, hydrobiology, environmental engineering, and marine transportation economics.

CGLS does not itself offer specific Lake- or marine-related undergraduate courses; these are taught by individual faculty members in their respective departments and colleges. The CGLS instructional role begins at the graduate level with seminars, training cruises, and above all, education through ongoing research. The establishment of CGLS in its present form in 1966 coincided with the decision to expand UWM into the second major doctoral university in what later became the statewide University of Wisconsin System. The CGLS vessel base and research activities are located at the UW Great Lakes Research Facility, a nine-acre site at 600 East Greenfield Avenue, Milwaukee, with 1,300 feet of deep-water dock on the harbor waterfront. The modern 125,000 square foot building was purchased from the Allen Bradley Company in 1973. In 1979, remodeling was undertaken with National Science Foundation and State of Wisconsin support, and one third of the space has been transformed into 17 specialized laboratories (including microbiological, sedimentological, ice-research, and fishery research complexes, and laboratories for aquatic chemistry,

limnology, and marine engineering) and also general services to support vessel operations, instrument development, and data analysis.

The Facility not only houses CGLS; it also serves as a base of operations for some programs of the UW Sea Grant College, the Marine Studies Center in Madison, and other UW System Great Lakes related activities and provides a regional logistic base for the State and Federal agencies, as well as for other universities and individual investigators active in Great Lakes and aquatic research. In 1978 the Medical College of Wisconsin and UWN were jointly awarded a grant to establish one of the National Marine and Freshwater Biomedical Research Centers at the Facility.

Specifically designated degrees in marine sciences are not offered, but the following programs provide the opportunity for graduate students to specialize in Great Lakes- or marine-related fields.

The following degrees are offered:

1. **M.S.** Programs in: Atmospheric Sciences, Botany, Engineering, Geography, Geological Sciences including Atmospheric Sciences, and Zoology.

2. **Ph.D. in Biological Sciences**

3. **Ph.D. in Geosciences**

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Dean

The Graduate School

University of Wisconsin-Milwaukee

P.O. Box 413

Milwaukee, WI 53201

**VIRGINIA INSTITUTE OF
MARINE SCIENCE
COLLEGE OF WILLIAM AND MARY**
Gloucester Point, Virginia 23062

The School of Marine Science at the Virginia Institute of Marine Science offers the **Master of Arts** and the **Doctor of Philosophy** degrees in marine science. Majors in biological oceanography, physical oceanography, chemical oceanography, geological oceanography, fisheries oceanography, and marine resource management (marine affairs) are available at both levels. A program in marine education is through the School of Education.

The College of William and Mary is the second-oldest university in the United States. It is a state-supported institution that prides itself on a dedication to excellence in its undergraduate program and a few select graduate programs. Graduate programs include marine science, law, physics, business, history, education and psychology.

The School of Marine Science had its beginning in 1940 as the Virginia Fisheries Laboratory in the Biology

Department of the College. The School now encompasses the Virginia Institute of Marine Science, the principal marine research facility of the Commonwealth.

The School enrolls about 130 students; five to ten percent of the students are from foreign countries. The majority of students have a biological orientation. About forty percent are women. Recruiting initiatives in the coming years will be focused on increasing enrollment in the physical, geological, and chemical sciences and increasing the number of minority students in all disciplines. In recent years, graduating students have primarily entered the governmental or industrial sector. Over ninety-five percent of the recent graduates hold positions in which they use their graduate training.

The primary orientation of the approximately 50 person faculty is towards estuarine, continental shelf and slope environments. Many of the faculty members are actively engaged in applied research of direct concern to industry and management agencies. Students often find their assistantship duties and/or research topics bring them into close contact with industry and management agencies at state, federal, and regional levels.

The M.A. degree requires 24 semester hours completed with a grade of B or better, with at least 12 hours in advanced courses and six hours of thesis work; successful completion of a comprehensive examination and defense of the thesis; and reading knowledge of one foreign language. The Ph.D. requires three years of study beyond the baccalaureate, a reading knowledge of one foreign language, successful completion of a course of study determined by the student's committee, and a comprehensive examination and a dissertation defense. Students working on both degrees must spend one academic year in residence (at least 12 hours each semester). The program is interdisciplinary, and all students are required to take core courses in biological, chemical, physical, and geological oceanography and statistics. Students interested in careers in government and industry are encouraged to take environmental law and marine affairs.

There is ample opportunity for students to engage in field-oriented theses and dissertation research, and all students are encouraged to participate in field studies to gain experience in research at sea.

The main research campus of the School of Marine Science/Virginia Institute of Marine Science is located at Gloucester Point on the York River. There is a branch laboratory at Wachapreague on Virginia's Eastern Shore that is ideally suited for research on the barrier island and lagoon systems. The Institute is well equipped with modern laboratory and seagoing instrumentation. Computer support is provided by a PRIME 750 on campus with access to the main William and Mary computers in Williamsburg and a number of microprocessors. The Institute is equipped with running salt water. The major equipment includes transmission and scanning electron microscopes, a gas chromatograph/mass spectrometer, computer-interfaced gas chromatographs, an atomic absorption spectrometer, Neil

Brown STDs, a hydraulic flume, and a wave test basin. The Institute has a number of vessels for estuarine and coastal operations and an aircraft for remote-sensing research.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Associate Dean

School of Marine Science

Virginia Institute of Marine Science

College of William and Mary

Gloucester Point, VA 23062

(804) 642-2111, or 642-6131

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061

Virginia Polytechnic Institute and State University has research and teaching facilities located on the main campus in Blacksburg and has a small marine laboratory in Hampton, Virginia.

Major campus research facilities in fisheries include seven laboratories and a cold storage room in Cheatham Hall, as well as a large equipment storage building and a fish culture building. In ocean engineering, research facilities include a towing tank for ship and submarine hydrodynamic studies; a cavitation tank, or rotating ocean flow basin; a large, low-speed wind tunnel for air flow simulation of hydrodynamic phenomena; and a wide range of structural testing equipment. Two small power boats are used for studies on nearby deep lakes.

The facility at Hampton, Virginia, includes a research laboratory, classroom and office space, with estuarine research carried out using an 18-foot electroshocking boat and six smaller craft.

The following degrees are offered:

1. **B.S. in Aerospace and Ocean Engineering.** Requires 204 quarter credits, including 30 credits of humanities and 18 credits of approved technical electives.

2. **M.S. in Aerospace and Ocean Engineering.** Requires 45 quarter credits, including 9-15 for thesis, or non-thesis option, and oral examination.

3. **Ph.D. in Aerospace Engineering** with a specialty in Ocean Engineering requires 135 quarter credits including 45-85 for thesis.

4. **B.S. in Forestry and Wildlife** with Fisheries option. Requires 200 quarter credits including mathematics through one year of calculus and matrix algebra, statistics, computer science, 25 credits of physical science, 30 credits of biological science, 29 credits of fisheries and wildlife, and 39 credits of humanities and social sciences.

5. **M.S. in Fisheries and Wildlife Sciences.** Requires 45 quarter credits including a maximum of 15 for thesis, a comprehensive examination, and defense of thesis. Meets educational requirements for certification by American Fisheries Society and as fisheries biologist with U.S. Civil Service Commission.

6. **Ph.D. in Fisheries and Wildlife Sciences.** Requires 135 quarter credits including a maximum of 85 for research and dissertation; qualifying exam, comprehensive preliminary exam, and dissertation defense.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Department of Aerospace and Ocean Engineering

Virginia Polytechnic Institute and State University

Blacksburg, VA 24061

or,

Chairman

Department of Fisheries and Wildlife Science

Virginia Polytechnic Institute and State University

Blacksburg, VA 24061

WALLA WALLA COLLEGE

College Place, Washington 99324

The College offers marine science courses at its marine station on Puget Sound near Anacortes. Supporting coursework is offered on the main campus at College Place. Facilities for the maintenance and use of marine organisms in research are available in the life science complex completed on the main campus in 1967. The Walla Walla College Marine Station provides two teaching and research laboratory buildings serviced by a circulating saltwater system. In addition, the marine station operates a research vessel, the 45-foot *Seastar*, and has a 16-foot Boston Whaler. A number of smaller boats are available for research work associated with the courses being offered. Scuba equipment is available.

The degree of **M.S. in Biology** with an emphasis in marine biology is offered in the Department of Biology.

All students must complete a minimum of 45 graduate-approved credits, pass written and oral departmental examinations, and demonstrate ability to carry out independent research fulfilling the thesis requirement.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman, Department of Biology

Walla Walla College

College Place, WA 99324

WASHINGTON TECHNICAL INSTITUTE

Washington, D.C. 20008

Washington Technical Institute has an Environmental Science Department which offers a program of technical training in Marine Science Technology.

The principal teaching facility is the main campus at 4100 Connecticut Avenue, N.W., Washington, D.C.

The field stations for research, laboratory, and ship training are located at Wallops Island, Virginia, and at Lewes, Delaware. Courses of study at these two field stations are offered throughout the summer by the Marine Science Consortium, of which Washington Technical Institute is a member. Equipment use and handling is taught aboard the *R/V Annandale*, a 90-foot vessel and aboard Boston Whalers and MBT's. Equipment includes salinometers, STD recorders, turbidimeters, Nansen bottles, Niskin samplers, corers and trawls. Scuba diving is offered during the summer at the main campus.

An **Associate of Applied Sciences (AAS)** is offered.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman, Environmental Science Department

School of Agriculture and Natural Resources

Washington Technical Institute

4100 Connecticut Avenue, N.W.

Washington, D.C. 20008

WEBB INSTITUTE OF NAVAL ARCHITECTURE

Glen Cove, New York 11542

The College offers a course of study in naval architecture and marine engineering to train and educate young persons who are interested in the design and construction of ships.

Specialized facilities include a 93-foot long model basin with wave maker, a flow channel, a marine engineering laboratory which includes operating components of commonly encountered marine machinery and a time-sharing computer facility.

The **Bachelor of Science in Naval Architecture and Marine Engineering** is offered by the Institute.

In addition to required core courses in naval architecture and marine engineering, mathematics, science, basic engineering and the humanities, which together with the required core total 148 credit hours, are required for the degree.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

President

Webb Institute of Naval Architecture

Glen Cove, NY 11542

WESLEYAN UNIVERSITY

Middletown, Connecticut 06457

The Department of Earth and Environmental Sciences at Wesleyan University offers **undergraduate major programs** both in earth science and in environmental science. Focus on the latter is on marine science, especially of the Connecticut River estuary and the near-shore and coastal zone.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman

Department of Earth & Environmental Sciences

Wesleyan University

Middletown, CT 06457

(203) 347-9411 x2282

WESTERN CONNECTICUT STATE UNIVERSITY

Danbury, Connecticut 06810

The graduate program, **Master of Arts in Oceanography and Limnology**, is housed in the Department of Biological and Environmental Sciences. The program provides an opportunity for advanced study in biological, chemical, geological, and physical aspects of the aquatic environment through intensive classroom presentations and discussions, together with field and laboratory experiences in marine and fresh water environments.

The program prepares the student to: pursue advanced studies in aquatic sciences; pursue a career in industrial, public, or technical services relating to aquatic sciences; and to upgrade his or her understanding in aquatic sciences for secondary school teaching.

It is a unique program of the higher education system in Connecticut in that it combines both saltwater and freshwater studies within the confines of one program. A strong environmental approach is taken through our course and research offerings. Field studies form an integral part of the program. We have conducted field studies in cooperation with the National Marine Fisheries Service, Milford Laboratory, Milford, Connecticut, situated on the shore of Long Island Sound and Lamont-Doherty Geological Observatory, Palisades, New York. Research collaboration is also arranged with the Milford Laboratory and the Nature Conservatory at Lake Lacawac, Pennsylvania.

A total of 30 credits is required to complete the degree (M.A.). Two options are offered in the program, with and without thesis.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:
Dean
Graduate Studies and Extension Service
Western Connecticut State University
Danbury, CT 06810

WESTERN KENTUCKY UNIVERSITY

Bowling Green, Kentucky 42101

Western Kentucky University is a charter member of the Upper Cumberland Biological Field Station located at Tech Aquaculture Center Hill Reservoir near Cookeville, Tennessee. The Station offers at least four biology courses in each of two five-week summer sessions including such courses as Freshwater Algae, Limnology, Ichthyology, Freshwater Invertebrates and other courses emphasizing freshwater habitats of the central United States.

The graduate program centers around the **Master of Science** with a **Cooperative Doctoral** program with the University of Louisville. Marine science courses are limited to special summer courses offering investigations in marine invertebrates at locations in the Gulf of Mexico and in Caribbean waters.

The prerequisites for the Master of Science Program are: a minimum undergraduate grade point average of 2.50 (4.0 scale) and a combined verbal-quantitative-qualitative score on the Graduate Record Examination of at least 1200, and two courses each in physics and inorganic chemistry and one course in organic chemistry for unconditional acceptance to the graduate program in biology.

Assistantships for teaching and research are awarded on a competitive basis and applicants are considered prior to each fall and spring semester. Summer stipends are usually available. Eligibility for assistantship requires a minimum undergraduate grade point average of 2.75.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director of Graduate Programs in Biology
Department of Biology
Western Kentucky University
Bowling Green, KY 42101

WESTERN MICHIGAN UNIVERSITY

Kalamazoo, Michigan 49001

Western Michigan University offers opportunities for graduate students in either biology or geology to concentrate in aquatic sciences. This may be in the Great Lakes or in marine waters. Active teaching and research programs in both areas are in progress. Excellent laboratory facilities are available in both depart-

ments. Opportunities for summer field courses exist in addition to the usual on-campus studies. The University is a member of two consortiums, each of which has marine-oriented summer programs. These are Central States Universities, Inc., and Associated Universities for International Education. The latter operates out of St. John's College in Belize, British Honduras.

The following degrees are offered. Concentrations in marine-related aspects of either are possible.

1. **M.A. in Biology.** Requires 30 credit hours in biology and related areas and completion and defense of a thesis.

2. **M.A. in Geology.** Requires 30 credits hours (as many as nine hours may be outside the department), completion of a thesis, and defense of a thesis.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Chairman
Department of Geology
Western Michigan University
Kalamazoo, MI 49001

WESTERN WASHINGTON UNIVERSITY

Bellingham, Washington 98225

The Leona M. Sundquist Marine Laboratory is located on Shannon Point at the junction of Rosario Strait and Guemes Channel in Anacortes, Washington. The Sundquist Laboratory is the marine facility that serves the Shannon Point Marine Center Consortium consisting of Washington regional universities, the Evergreen State College, and three local community colleges. It is administered by Western Washington University.

The academic program of the Shannon Point Marine Center consists of courses sponsored by the consortium as well as those offered by individual member institutions. Heaviest use of the laboratory occurs during the spring and summer quarters. Students are mainly undergraduates.

The laboratory stands on a 73-acre tract of maturing, second-growth forest. There is about half a mile of mainly embedded cobble marine beach and a five-acre, freshwater pond. There are 7 individual research laboratories, 2 instructional laboratories with a combined capacity of 48 students, a seminar room, a small reference collection and supporting facilities including more than 50 seawater tables. Boats available include: rowboats; a Zodiac; three Boston Whalers; an 18-foot Fiberform, trihulled launch; and a diesel powered, 36-foot cruising vessel, *Leona III*. The laboratory is an hour's drive from the main campus in Bellingham.

Western Washington University offers undergraduate concentrations in marine biology (**B.S. in Biology** through the College of Arts and Sciences, or **B.S. in Environmental Studies** through Huxley College of Environmental Studies). Oceanography-related courses

are also offered in the Departments of Geology, Geography and Psychology (behavior).

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director
Sundquist Marine Laboratory
1900 Shannon Point Avenue
Anacortes, WA 98221

WEST VIRGINIA UNIVERSITY

Morgantown, West Virginia 26506

The West Virginia University program in Marine Science is part of The Marine Science Consortium, Inc., located at Wallops Island, Virginia. Various courses in marine science are offered during our summer term. Laboratory and teaching facilities are all located at the Wallops Island Marine Science Center, Wallops Island, Virginia. Research vessels include the 50-foot *R/V Delaware Bay*, and the 40-foot *R/V Chincoteague Bay*. Classrooms, wet and dry laboratories, workshops, garages, dormitories, etc., are part of the center's facilities. In addition, all standard oceanographic equipment is available.

Although degrees are not offered in the specific areas of oceanography or marine biology, the **B.S., M.S., and Ph.D. degrees in Biology, Geology, and Wildlife Biology** are offered with an emphasis in the marine (including coastal) sciences.

Curriculum offered: available in school catalog.
Faculty appointments: available in school catalog.
To obtain further information, address inquiries to:
Director
Marine Science Program
201 Brooks Hall
West Virginia University
Morgantown, WV 26506
(304) 293-5201

WOODS HOLE OCEANOGRAPHIC INSTITUTION

Woods Hole, Massachusetts 02543

Research at the Institution encompasses the range of basic sciences as they apply to the marine environment: biology, physics, chemistry, geology, and geophysics, as well as ocean engineering and marine policy. Some 200 scientists and technicians and a support staff of about 600 are housed in four large laboratories and a variety of smaller facilities located in the village of Woods Hole and on the nearby Quissett Campus. Another 75 people operate three research vessels ranging from 177 to 245 feet in length, the deep-

diving submersible *Alvin* and mothership, and a small coastal vessel. Computer services are provided within the Institution and with necessary links to other institutions, and the library facilities are shared with the Marine Biological Laboratory and supplemented by collections of the Northeast Fisheries Center of the National Marine Fisheries Service and the Branch of Atlantic-Gulf of Mexico Geology of the U.S. Geological Survey, all located in Woods Hole. The village is located on the southwest corner of Cape Cod about 80 miles south of Boston.

The Woods Hole Oceanographic Institution, in concert with the Massachusetts Institute of Technology, and with cooperation from several other universities, offers graduate degree programs in oceanography and oceanographic engineering. The MIT/WHOI Joint Program is the principle pathway for the majority of students entering graduate studies at Woods Hole.

Students admitted to the Joint Program in Oceanography/Oceanographic Engineering have access to the facilities and the staff, as well as the extensive physical facilities of both institutions. All decisions from admission to the conferring of the degree — a single document issued by both institutions — are made by consensus of the joint MIT/WHOI committees. All students applying to the Woods Hole Oceanographic Institution for graduate degree programs are first considered for admission to the Joint Program. For qualified students whose interests are not best served by the Joint Program, programs of advanced study and research may be offered by the Woods Hole Oceanographic Institution which lead to the Ph.D. in Oceanography, awarded by WHOI alone. Cross-registration arrangements with Harvard University and Brown University, and other less formal cooperative agreements with the Biology and Geology and Geophysics Departments at Yale University and other schools, provide opportunities to develop special academic study programs tailored to the individual needs of the student.

The following degrees are offered in Oceanography:

1. **Ph.D. and Sc.D. in Oceanography**, offered jointly by Woods Hole Oceanographic Institution and the Massachusetts Institute of Technology.

2. **Ph.D. in Oceanography** offered by the Woods Hole Oceanographic Institution.

Students in either doctoral degree program may concentrate in one or more of the following areas: biological oceanography, chemical oceanography, marine geology, marine geophysics, or physical oceanography.

The usual steps to a degree are: enter the program the summer preceding the first academic year and work as a research assistant in Woods Hole; follow an individually designed program of advanced study and research in preparation for a general examination to be taken before the third year (the general examination tests for a comprehensive knowledge of oceanography and ability to identify and explore research problems); and submit a dissertation on significant original theo-

retical or experimental research and conduct an oral defense of the thesis.

Each student formulates, with the assistance of academic advisors (at least one from each institution), a program of studies involving courses, seminars, and research activities. There are no formal course requirements, but each degree candidate is expected to gain some degree of familiarity with the principal areas of oceanography, in addition to demonstrating a thorough knowledge of at least one major field of specialization. Place of residence is determined by the student's outlined program of study and research.

Courses available to students in the above programs include the many courses offered by the Massachusetts Institute of Technology, and most specifically those offered by the Departments of Biology, Earth and Planetary Sciences, and Meteorology. In addition, course offerings are supplemented by numerous seminars and directed studies based on the individual needs of the students. Most courses are generally offered on an alternate year schedule and are numbered and given credit hours in accordance with the MIT system.

OCEANOGRAPHIC ENGINEERING: Joint degree programs are offered by the Woods Hole Oceanographic Institution and the Massachusetts Institute of Technology for students interested in applying a basic engineering knowledge to understanding and solving problems related to oceanography. The program is conducted jointly by the two institutions through the Department of Ocean Engineering at WHOI and through any one of the following engineering departments at MIT: Chemical Engineering, Civil Engineering, Electrical Engineering, and Computer Sciences, Materials Science and Engineering, Mechanical Engineering, or Ocean Engineering.

The following degrees are offered:

1. **Engineer's degree in Oceanographic Engineering** (degree designates basic engineering discipline, e.g., "Electrical Engineer"), offered jointly by WHOI and MIT.

2. **Ph.D. and Sc.D. in Oceanographic Engineering** offered jointly by WHOI and MIT.

Specific degree requirements vary slightly depending on the student's department affiliation at MIT. In general, however, all students for the Engineer's degree will be expected to: meet all formal requirements of the pertinent MIT department, which normally means a minimum of three academic terms of residence at MIT, primarily enrolled in required engineering courses; be in residence at WHOI for the first two summers (includes entering program in June instead of September) participating in ongoing research activities; gain exposure to oceanography and oceanographic engineering by taking ocean-related courses (at least two) and working as a research assistant on oceanographic projects; preparing a thesis on an oceanographic engineering topic that meets the approval of co-advisors from MIT and WHOI; and complete the program in three years.

Doctoral degree candidates normally follow the same pattern of course requirements and residency as the Engineer's degree candidates during their first two years. By the end of their second year, doctoral candidates will have had to pass a two-part examination and to present an acceptable plan for a dissertation. At this time a student will take up residence at the institution most convenient for carrying out the dissertation research. Doctoral degree candidates are expected, under normal circumstances, to complete the program in four years.

In addition to the many courses offered at the Massachusetts Institute of Technology, students in these programs are expected to take several of the oceanographic engineering courses offered by WHOI staff, as well as some of the oceanography courses listed under the oceanography degree programs.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Education Office

Woods Hole Oceanographic Institution

Woods Hole, MA 02543

(617) 548-1400 x2200, 2219

or, refer to listing under the Massachusetts Institute of Technology for additional information on the MIT/WHOI Joint Program.

YALE UNIVERSITY

New Haven, Connecticut 06520

Instruction in the marine sciences is offered principally in the Departments of Geology and Geophysics and Biology. There is also a joint program in marine biology with Woods Hole Oceanographic Institution, in which students may take courses or do research at either institution. An interdepartmental program in geophysics is offered by the Departments of Geology and Geophysics and Engineering and Applied Science.

The following degrees are offered:

1. **B.S. or B.A.**, generally after four years of undergraduate study.

2. **Ph.D.**, generally after four years of study and research beyond the bachelor's level.

Curriculum offered: available in school catalog.

Faculty appointments: available in school catalog.

To obtain further information, address inquiries to:

Director of Graduate Studies

(Department of Interest)

Yale University

New Haven, CT 06520

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